

Biology - 9700

■ 28 Questions

Topics Covered :

- ✓ 6.1 - Structure of nucleic acids and replication of DNA
- ✓ 1.2 - Cells as the basic units of living organisms
- ✓ 6.2 - Protein synthesis
- ✓ 3.2 - Factors that affect enzyme action
- ✓ 2.2 - Carbohydrates and lipids
- ✓ 4.1 - Fluid mosaic membranes
- ✓ 4.2 - Movement into and out of cells
- ✓ 2.3 - Proteins
- + 13 more topics...

Join Us for more resources
or visit [bestgradez.com](https://www.bestgradez.com)



Question No 1 - (9700_m25_22_5)

Subsection Topics: (a) : 6.1 - Structure of nucleic acids and replication of DNA, 1.2 - Cells as the basic units of living organisms | (b) : 6.2 - Protein synthesis | (c) : 3.2 - Factors that affect enzyme action

(a) Eukaryotic cells and prokaryotic cells contain DNA.

Complete the passage about DNA in eukaryotic cells and prokaryotic cells, using the most appropriate terms.

In eukaryotic cells, the DNA is located mainly in the chromosomes of the nucleus. Chromosomal DNA is associated with proteins called Two other eukaryotic cell structures that contain DNA are mitochondria and

In prokaryotic cells, for example, the DNA is found in the and is usually circular.

[4]

(b) Fig. 5.1 shows transcription of the first six nucleotides of a gene by the enzyme RNA polymerase. The bases of the first six nucleotides on DNA strand X are shown, but the bases on the template DNA strand are **not** shown.

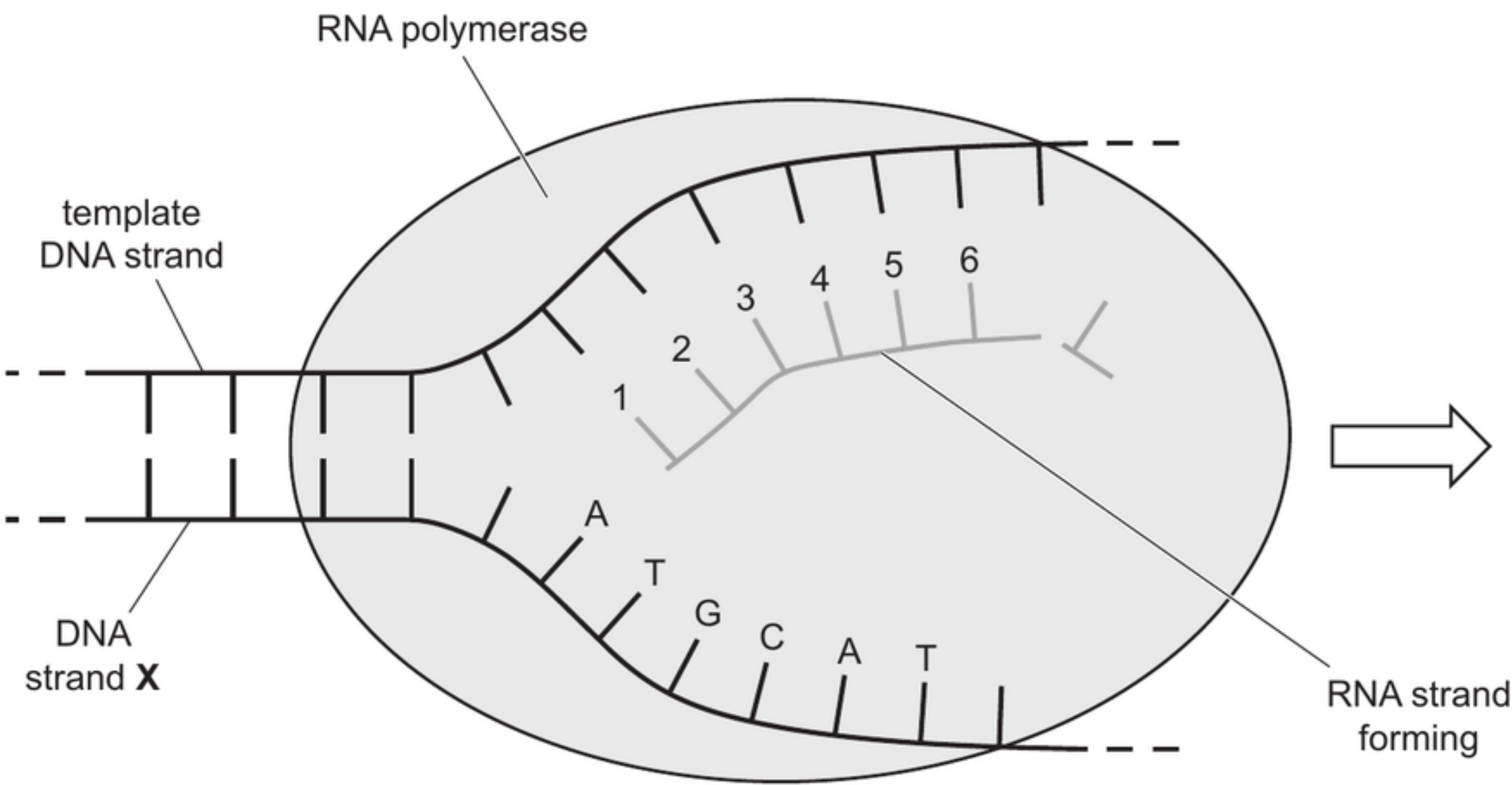


Fig. 5.1



(i) State the term used to describe the non-template DNA strand labelled X in Fig. 5.1. [1]

(ii) Name the RNA strand formed during transcription of a eukaryotic gene. [1]

(iii) Complete Table 5.1 to show the letters of the six bases indicated on Fig. 5.1 by the

DO NOT WRITE IN THIS MARGIN

numbers 1 to 6.

Table 5.1

1	2	3	4	5	6

[1]

- (c) RNA polymerase is composed of several polypeptides that move together and change shape as the enzyme performs its functions.

The death cap mushroom, *Amanita phalloides*, produces a toxin called alpha-amanitin, which binds to RNA polymerase at a site other than the active site. Alpha-amanitin reduces the activity of RNA polymerase.

Use the information provided to suggest how alpha-amanitin reduces the activity of RNA polymerase.

.....

.....

.....

.....

.....

.....

..... [3]

[Total: 10]

Question No 2 - (9700_m24_22_1)

Subsection Topics: (a) : 2.2 - Carbohydrates and lipids, 4.1 - Fluid mosaic membranes | (b) : 4.2 - Movement into and out of cells | (c) : 1.2 - Cells as the basic units of living organisms, 2.3 - Proteins, 3.2 - Factors that affect enzyme action

(a) Fig. 1.1 is a diagram representing part of the phospholipid bilayer of a cell surface membrane.

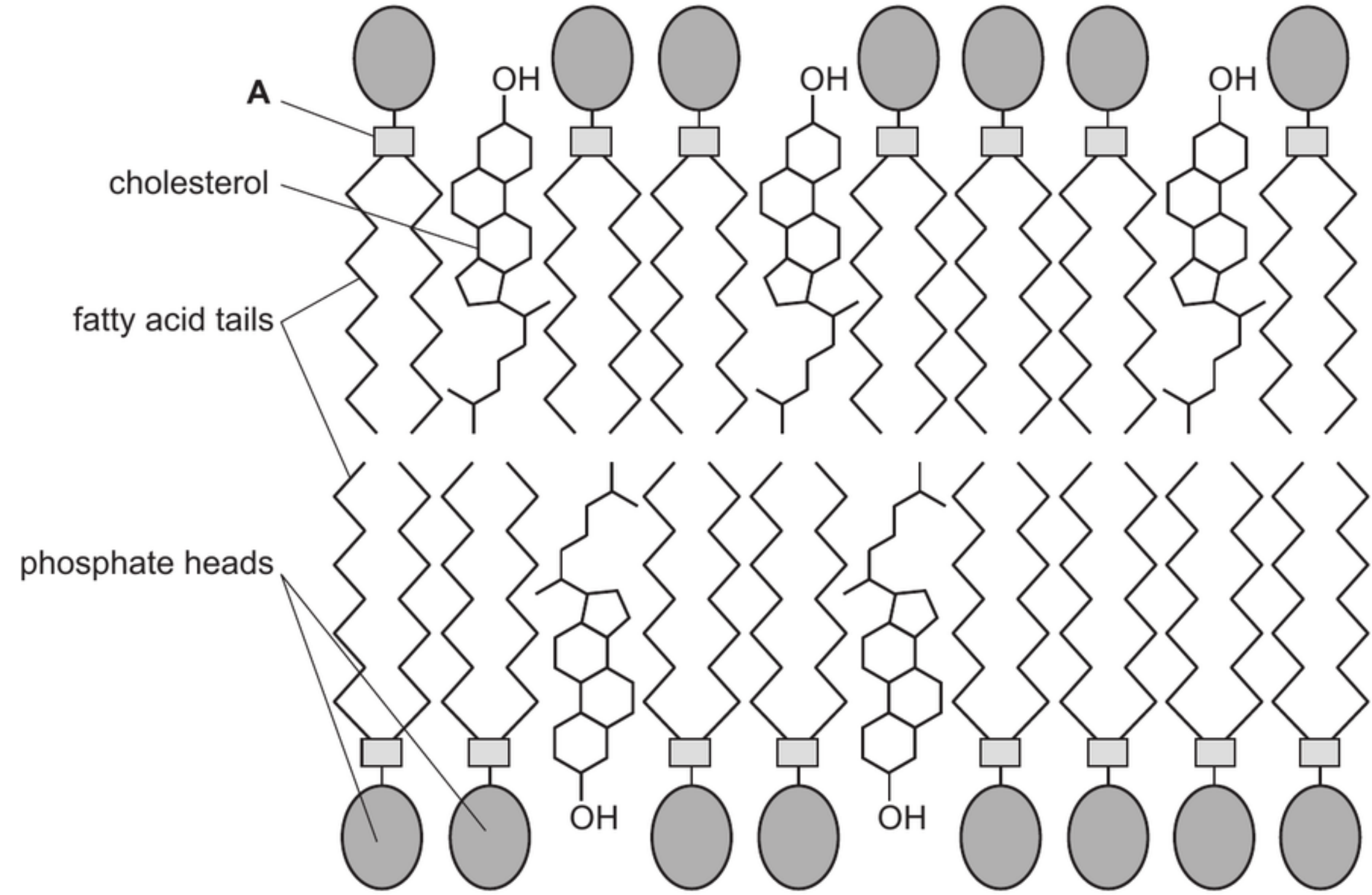


Fig. 1.1

(i) Identify the part of a phospholipid molecule, labelled **A** in Fig. 1.1, that forms bonds with the phosphate heads and with the fatty acid tails.

..... [1]

(ii) Cholesterol is an important lipid component of many cell surface membranes. Fig. 1.2 shows the structure of a cholesterol molecule.

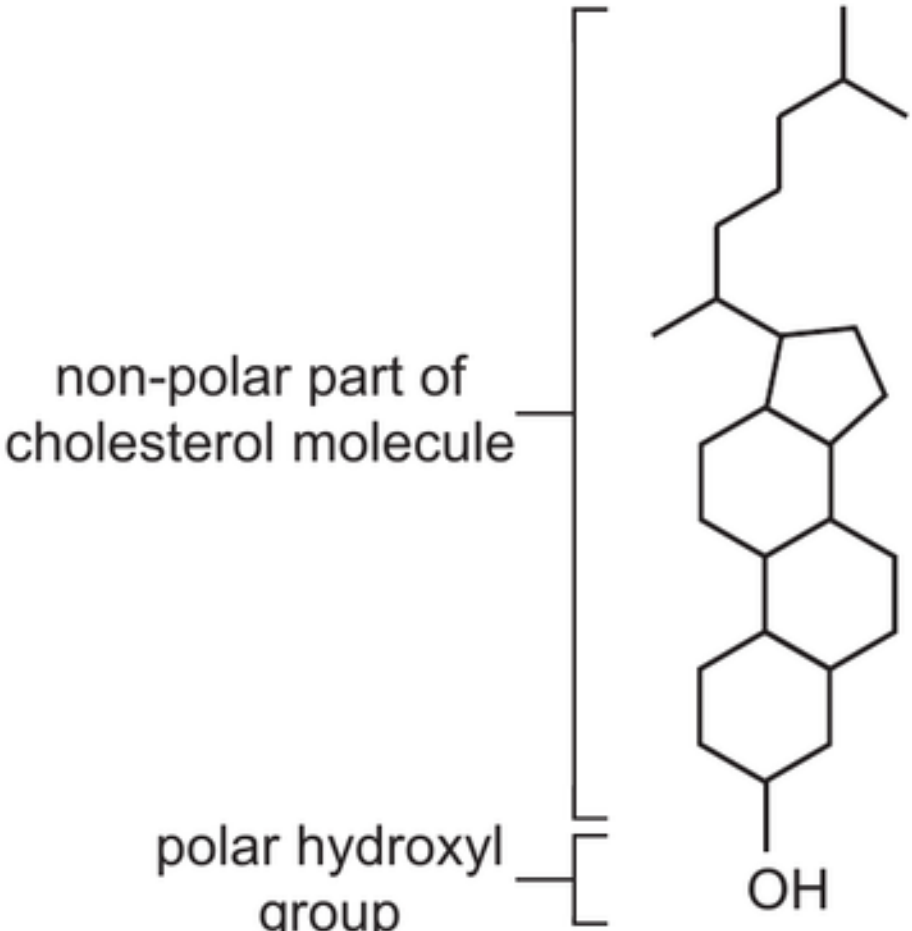


Fig. 1.2

Using the information in Fig. 1.2, explain the orientation (positioning) of cholesterol molecules in the phospholipid bilayer, as shown in Fig. 1.1.

.....
.....
..... [1]

(iii) State **one** role of cholesterol in phospholipid bilayers.

.....
.....
..... [1]

(b) (i) Explain why sodium ions **cannot** cross phospholipid bilayers by simple diffusion.

.....
.....
..... [1]

(ii) Ions and some molecules move across cell surface membranes by facilitated diffusion and active transport.

Compare facilitated diffusion and active transport by stating **one** way in which they are similar and **two** ways in which facilitated diffusion is different from active transport.

similarity
.....
difference 1
.....
.....
difference 2
.....
.....

[3]

(c) Prostaglandins are small lipids produced in many tissues of the body. One role of prostaglandins is to cause inflammation at the site of an injury or infection. Inflammation is the normal first

response of the immune system to injury or infection.

Cyclooxygenase (COX) is an enzyme that catalyses one of the steps in the reaction pathway for the formation of prostaglandins from phospholipids. The reaction pathway occurs in the smooth endoplasmic reticulum (SER) of cells. Part of the reaction pathway is shown in Fig. 1.3.

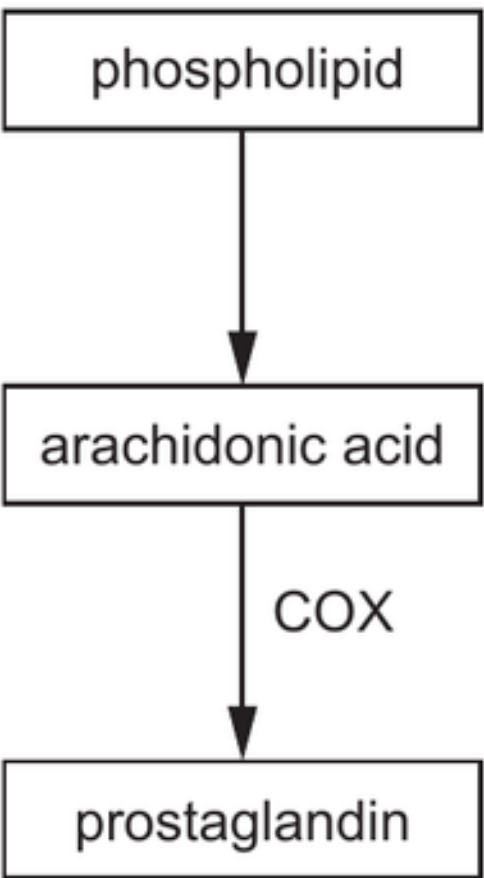


Fig. 1.3

- (i) Suggest an advantage for this reaction pathway occurring in the smooth endoplasmic reticulum of a cell rather than in the cytoplasm.

.....
.....
..... [1]

- (ii) Sometimes inflammation can have side-effects, such as pain. Aspirin is a drug that can be used to reduce these side-effects.

Aspirin reduces the catalytic activity of the COX enzyme by modifying the R-group of one of the amino acids.

Suggest how modifying the R-group of an amino acid in the COX enzyme can reduce the catalytic activity of the enzyme.

.....
.....
.....
.....
.....
..... [3]

- (iii) Prostaglandins are examples of cell-signalling molecules.

Outline the process of cell signalling that leads to a response by the cells involved in inflammation.

.....
.....
.....
.....
..... [2]

(a) A class of students was studying the features of some human pathogens. One of the students constructed a flow chart to identify four different human pathogens. The student used information about the structure and mode of transmission of each of these pathogens.

Fig. 3.1 shows the partially completed flow chart.

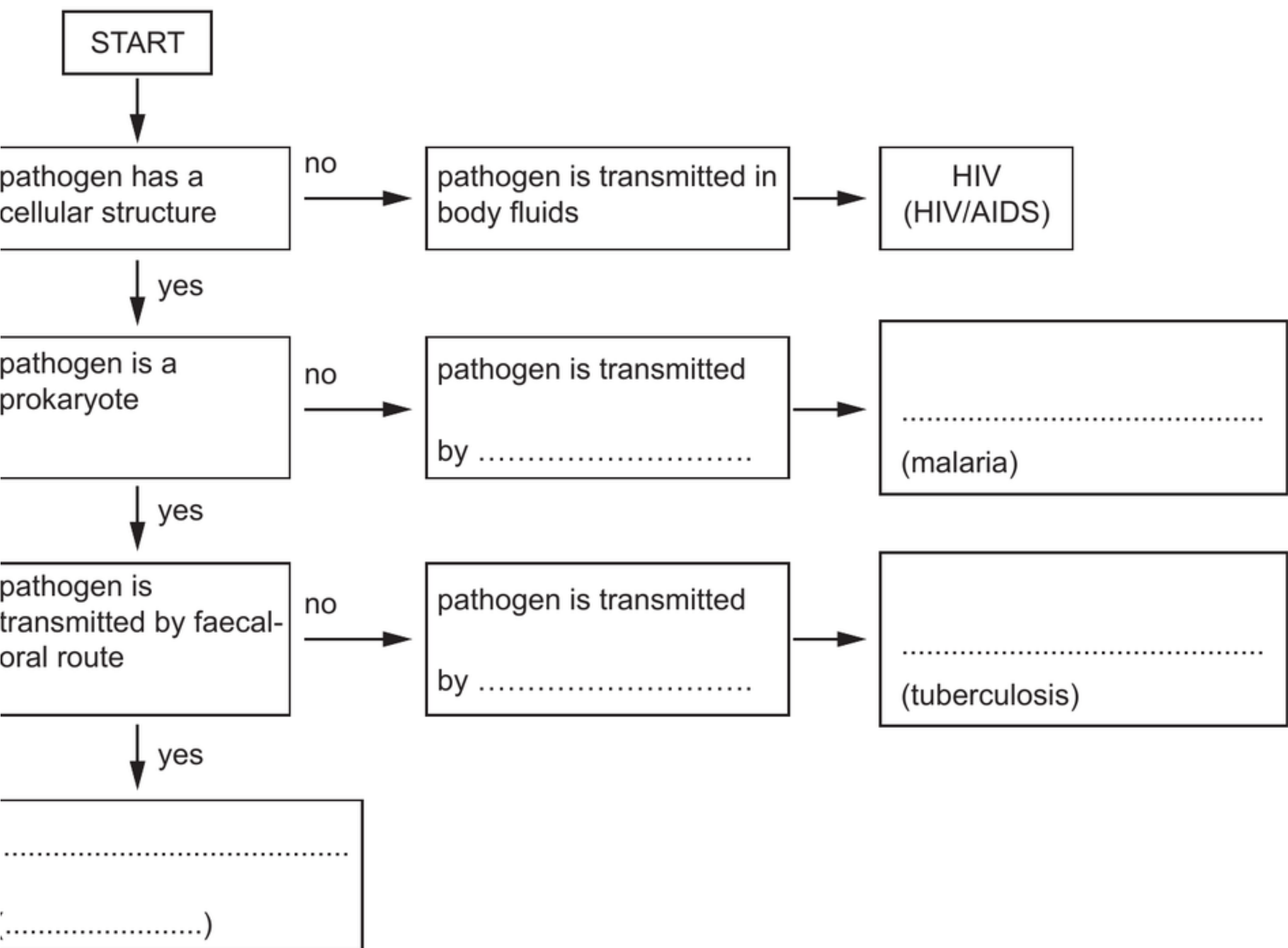


Fig. 3.1

Complete the flow chart in Fig. 3.1 by identifying:

- the modes of transmission
- the scientific names of the pathogens
- the name of one of the diseases.

[5]

(b) HIV has a nucleic acid core of RNA. The virus also contains the enzyme reverse transcriptase.

After HIV enters T-lymphocytes, reverse transcriptase catalyses the formation of DNA using activated DNA nucleotides with the viral RNA as a template.

Some drugs, such as tenofovir, have been developed to inhibit the action of reverse transcriptase.

The structure of tenofovir is similar to the structure of deoxyribose adenosine monophosphate, as shown in Fig. 3.2.

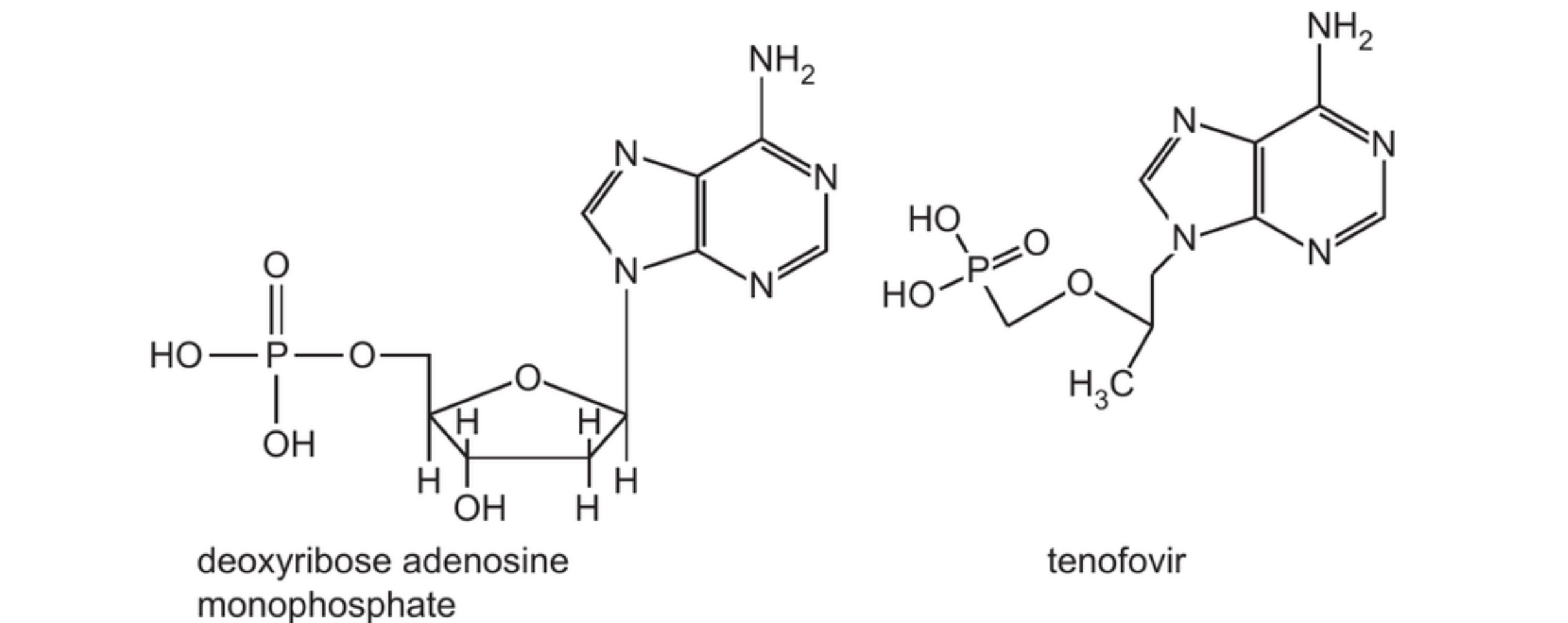


Fig. 3.2

After tenofovir is absorbed into cells it is phosphorylated twice and can be used by reverse transcriptase in the synthesis of DNA.

When a tenofovir molecule is added to the DNA strand being synthesised, the process stops.

Suggest the mechanism of action of tenofovir to prevent the synthesis of DNA by reverse transcriptase. Use the information in Fig. 3.2 in your answer.

.....

.....

.....

.....

..... [2]

(c) Pre-exposure prophylaxis (PrEP) is the use of therapeutic drugs to prevent the replication of HIV in the body following infection. The drugs are taken by people who are at risk of becoming infected. Tenofovir is one of these therapeutic drugs.

In 2016, the United Nations (UN) set a global target of 3 million PrEP users by 2020.

Table 3.1 shows the number of people across the world who received a therapeutic drug for PrEP in each of the years between 2012 and 2019.

Table 3.1

year	number of people who received PrEP
2012	10 000
2013	15 000
2014	27 500
2015	57 500
2016	95 000
2017	145 000
2018	340 000
2019	605 000

(i) Calculate the percentage of people who received PrEP in 2019 as a percentage of the target set by the UN in 2016.

Give your answer to the nearest whole number.

..... % [1]

(ii) PrEP does not prevent transmission of HIV.

State **and** explain how health authorities can reduce the transmission of HIV.

Question No 4 - (9700_s24_22_3)

Subsection Topics: (a) : 3.1 - Mode of action of enzymes | (b) : 10.2 - Antibiotics

Lysozyme is an antibacterial enzyme that was discovered in 1921 by Alexander Fleming, the scientist who discovered penicillin.

Lysozyme catalyses the hydrolysis of glycosidic bonds present in peptidoglycan molecules to form smaller products, NAG (N-acetylglucosamine) and NAM (N-acetylmuramic acid).

- (a) Before the induced fit hypothesis was proposed in 1958, scientists believed that the lock and key hypothesis explained how lysozyme catalyses the hydrolysis of peptidoglycan to its products.

Draw labelled **and** annotated diagrams in the space provided to show how the **lock and key hypothesis** was used to explain the mechanism of action of lysozyme on peptidoglycan.

[3]

- (b) Lysozyme and penicillin can be described as antibacterial agents.

Compare lysozyme **and** penicillin to show the similarities **and** differences between these two antibacterial agents.

Subsection Topics: (a) : 7.2 - Transport mechanisms | (b) : 3.1 - Mode of action of enzymes

(a) Describe **and** explain the roles of lignin and suberin in the transport of water through the roots and stem of a plant.

[4]

Fig. 4.1 is a diagram of the mode of action of laccase.



Fig. 4.1

Describe **and** explain the mode of action of laccase when catalysing the formation of lignin.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [5]

[Total: 9]

Question No 6 (9300 w24 21 5)

Subsection Topics: (a) : 3.2 - Factors that affect enzyme action | (b) : 3.2 - Factors that affect enzyme action

Trypsin is an enzyme which catalyses the hydrolysis of casein, a protein found in milk

Milk that contains casein has a cloudy, white appearance. As the casein is hydrolysed by trypsin, the milk changes in appearance to a clear (transparent), colourless solution.

A student carried out an experiment to investigate the effect of enzyme concentration on the rate at which trypsin hydrolyses casein.

The student added a solution of trypsin to a sample of milk and recorded the time taken for the milk to become transparent. The student repeated the experiment with different concentrations of trypsin. All other variables were kept constant.

Fig. 5.1 shows the results from the experiment.

- (a) (i) When the concentration of trypsin increases from 2.0% to 4.0%, the time taken for the milk to become transparent decreases by 48%.

Calculate the percentage decrease in the time taken for milk to become transparent when the concentration of trypsin increases from 0.25% to 0.5%.

Write your answer to the nearest whole number.

percentage decrease [1]

- (ii) Explain the results shown in Fig. 5.1.

[5]

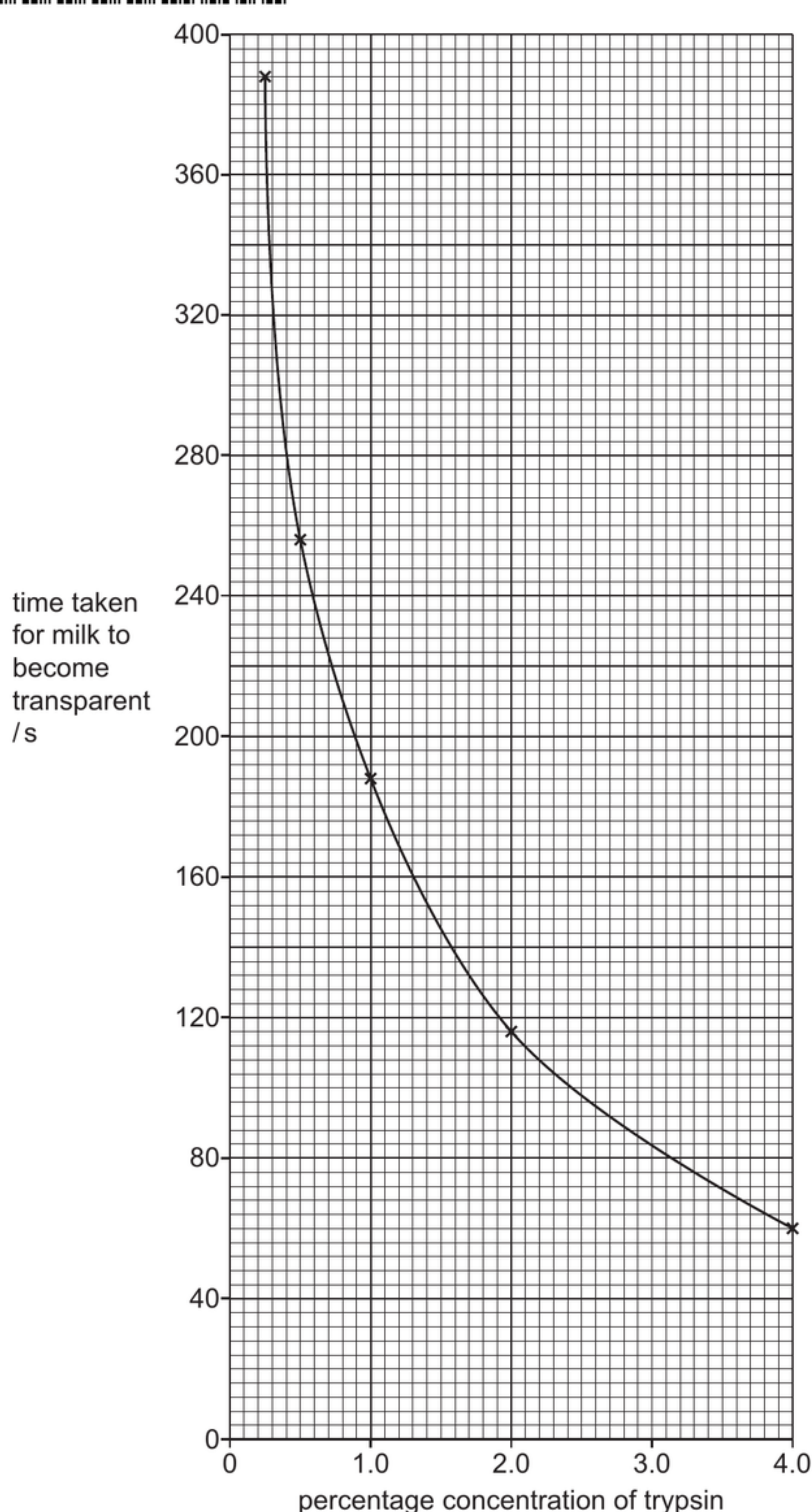


Fig. 5.1

- (b)** Trypsin has the potential to be used in a wide range of industrial processes.

The use of immobilised enzymes in industrial processes has many advantages.

Scientists investigated the effect of temperature on the activity of trypsin immobilised on the surface of a material and trypsin free in solution.

Table 5.1 shows the results of the investigation.

Table E 4

Table 3.1

temperature / °C	percentage of maximum activity of immobilised trypsin	percentage of maximum activity of trypsin free in solution
25	60	100
35	85	100
45	98	80
55	95	20
65	100	5

- (i) State a reason for the difference in percentage of maximum activity of immobilised trypsin and trypsin free in solution at 25 °C.

.....

 [1]

- (ii) Suggest **and** explain why the percentage of maximum activity of immobilised trypsin at 55 °C is higher than the percentage of maximum activity of trypsin free in solution at 55 °C.

.....

 [2]

[Total: 9]

Question No 7 - (9700 w24 22 2)

Subsection Topics: (d) : 1.2 - Cells as the basic units of living organisms, 8.2 - Transport of oxygen and carbon dioxide | (e) : 3.1 - Mode of action of enzymes | (a) : 10.1 - Infectious diseases | (b) : 1.1 - The microscope in cell studies | (c) : 1.2 - Cells as the basic units of living organisms

People who become infected with human immunodeficiency virus (HIV) are at risk of developing HIV/AIDs, particularly if antiretroviral therapy (ART) is not available.

- (a) In people infected with HIV, the use of ART also helps to reduce transmission of the virus to uninfected people.

Outline **two** control methods, other than ART, that can be used to reduce the transmission of HIV.

..... [2]

In people with HIV/AIDS, a serious lung disease known as pneumocystis pneumonia can result from infection by an opportunistic pathogen known as *Pneumocystis jirovecii*.

Fig. 2.1 shows *P. jirovecii* cells in one stage of their life cycle, as seen using a light microscope at a magnification of $\times 600$.

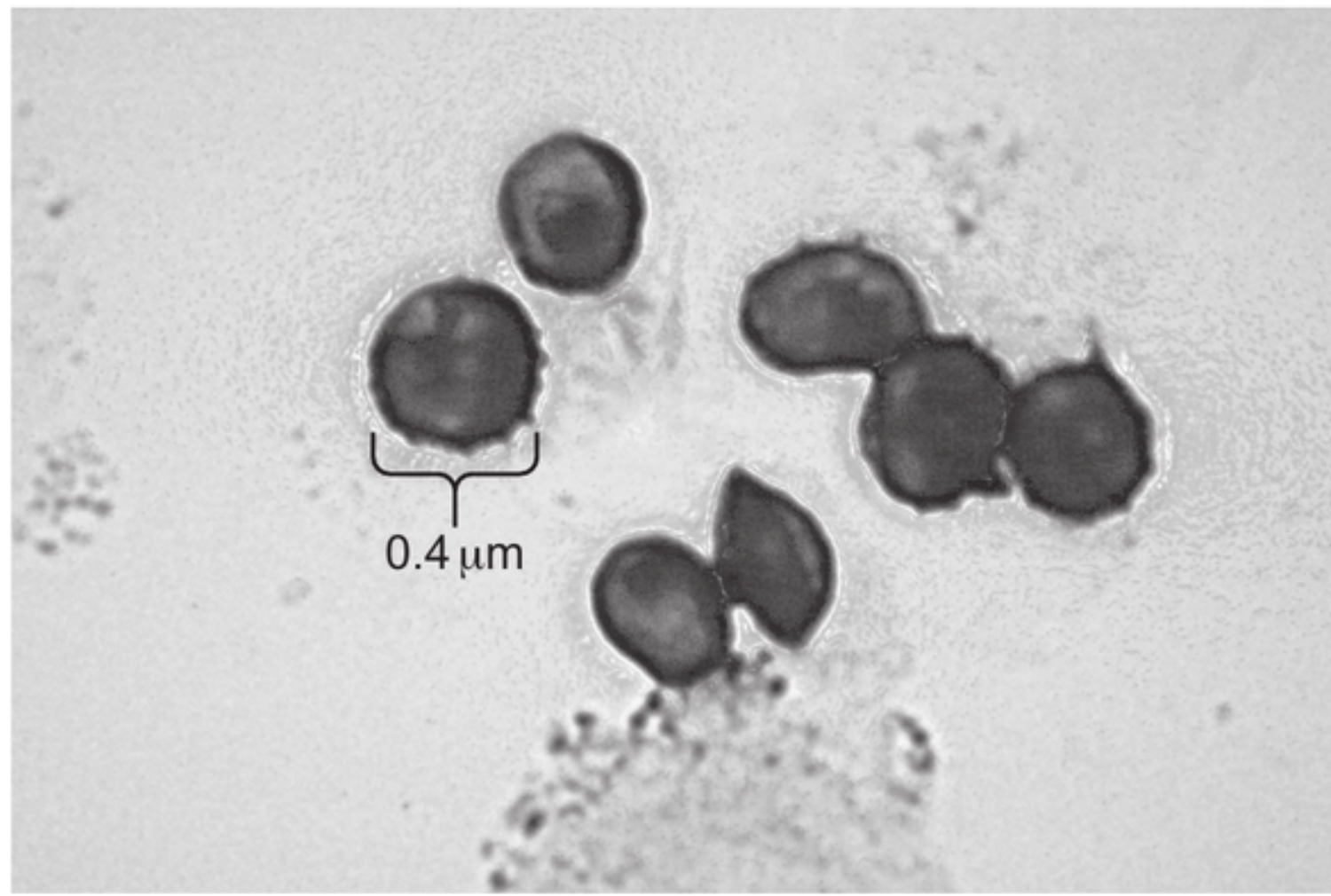


Fig. 2.1

- (b) Define magnification.
-
- [1]



- (c) Fig. 2.1 shows that *P. jirovecii* is a unicellular organism. Although the cells of many species of bacteria are the same size as those of *P. jirovecii*, research concluded that the organism is a eukaryote and is **not** a bacterium.

In 1988, analysis of ribosomal RNA (rRNA) resulted in *P. jirovecii* being classified as a fungus.

- (i) Studies of the structure of *P. jirovecii* have identified that the cell wall is made of polysaccharides such as chitin and 1,3- β -D-glucan.

Explain why this feature helped scientists to confirm that *P. jirovecii* is **not** a bacterium.

.....

.....

..... [1]

- (ii) Scientists have identified other features of the cell structure of *P. jirovecii*. Some of these are listed in Table 2.1.

Complete each row of Table 2.1 so that the table shows:

- four structural features identified in *P. jirovecii*
- one function for each structural feature
- whether the structural feature is present (✓) or absent (X) in bacterial cells.

Table 2.1

structural feature of <i>P. jirovecii</i>	function	present (✓) or absent (X) in bacterial cells
ribosomes	protein synthesis	
smooth endoplasmic reticulum		
Golgi body	modification of proteins and lipids	
	aerobic respiration	

[3]



- (d) *P. jirovecii* can adhere (attach) to squamous epithelial cells of the alveoli and to the network of fibrous proteins that support the alveolar wall, known as the extracellular matrix (ECM). Examples of proteins in the ECM are elastin and collagen.

Adhesion (attachment) of *P. jirovecii* to alveolar epithelial cells and the ECM stimulates the growth of its population.

- (i) Cell surface glycoproteins known as gpA glycoproteins are essential in allowing *P. jirovecii* cells to adhere to alveolar epithelial cells and ECM proteins.

Suggest how a gpA glycoprotein is able to adhere to alveolar epithelial cells and ECM proteins.

.....

.....

.....

.....

..... [2]

- (ii) One consequence of the pneumonia that results from *P. jirovecii* infection is a decrease in the quantity of oxygen that is delivered to body tissues.

Explain why a severe *P. jirovecii* infection results in a decrease in the quantity of oxygen that is delivered to body tissues.

.....

.....

.....

.....
.....
.....
.....
..... [3]



- (e) *P. jirovecii* produces an enzyme known as 1,3- β -D-glucan synthase. The enzyme catalyses the synthesis of 1,3- β -D-glucan.

The therapeutic drug caspofungin is a non-competitive inhibitor of 1,3- β -D-glucan synthase.

With reference to the mechanism of action of caspofungin, explain how the drug may be useful to treat cases of pneumonia caused by *P. jirovecii*.

.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
..... [5]

Subsection Topics: (a) : 3.1 - Mode of action of enzymes | (b) : 2.2 - Carbohydrates and lipids

- Scientists investigated the production of sugars from crop waste for biofuel production. The scientists discovered that a strain of the fungus *Penicillium citrinum*, isolated from soil, was a good source of three different extracellular enzymes, **M**, **N** and **O**. These enzymes break down polysaccharides in cell walls.

The scientists cultured *P. citrinum* in a liquid medium containing cell wall material. Samples of the liquid were taken, and the three enzymes were separated from the medium. Each enzyme was placed in a reaction mixture with an appropriate substrate. The activity of each enzyme was determined to give a measurement of the quantity of enzyme produced by *P. citrinum*.

The results are shown in Table 4.1.

Table 4.1

enzyme	maximum activity /arbitrary units
M	292.83
N	111.72
O	6.54

Optimum conditions for each enzyme were used to obtain the results in Table 4.1. The conditions were different for each enzyme.

The scientists carried out further research so that a solution containing the three enzymes (enzyme mixture) could be used for the most efficient production of sugars from crop waste.

Suggest what the scientists needed to find out in their research.

[4]

[4]

- (b)** Students investigated the composition of the cell wall of leaf cells of thale cress, *Arabidopsis thaliana*. The students began by isolating the cell wall components from the rest of the cell material.

The students used enzymes extracted from a fungal pathogen of *A. thaliana* to hydrolyse the cell wall components to smaller molecules.

The students prepared a reaction mixture containing the cell wall components and the enzymes.



After 24 hours, they separated and identified the smaller molecules found in the reaction mixture.

Four types of molecule were identified:

- short chains of β -glucose
- β -glucose
- peptides
- amino acids.

Explain the presence of these molecules in the reaction mixture after 24 hours of hydrolysis.

.....

.....

.....

.....

.....

.....

.....

.....

..... [4]

Question No 9 - (9700_m23_22_6)

Subsection Topics: (a) : 2.3 - Proteins | (b) : 3.2 - Factors that affect enzyme action

- (a) Collagen is the most common structural protein in vertebrates. Collagen provides the skin with flexibility and strength.

Explain how the structure of a collagen fibre provides the skin with strength.

.....

.....

.....

.....

.....

.....

..... [3]

- (b) The enzyme collagenase breaks down collagen. Collagenase has several important medical uses, such as in the treatment of burnt skin.

Scientists investigated the effect of pH on the activity of collagenase at 37 °C.

The results of their investigation are shown in Fig. 6.1.

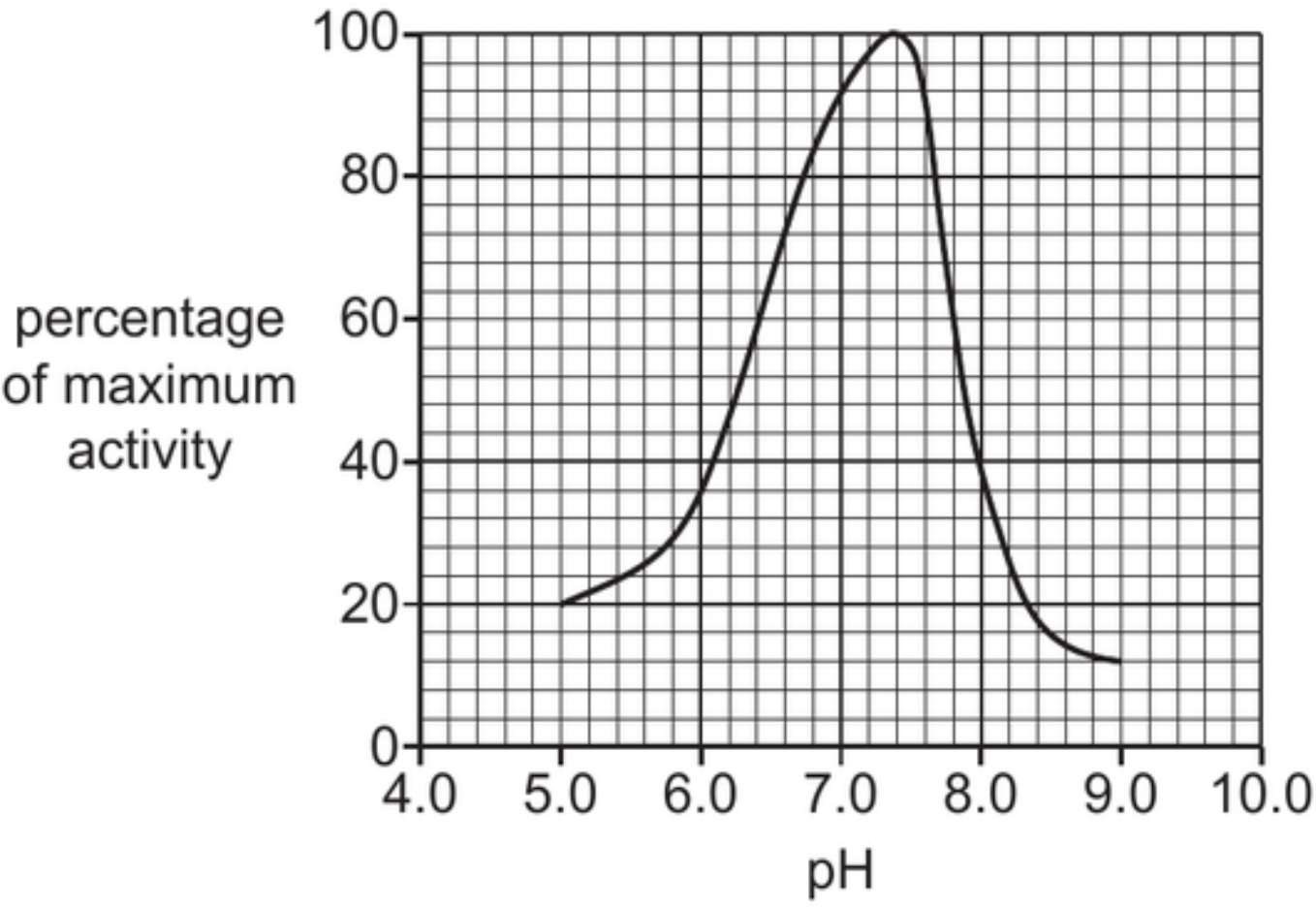


Fig. 6.1

Explain why the activity of collagenase is lower at pH 8.0 than at the optimum pH.

.....

.....

.....

.....

..... [2]

Subsection Topics: (a) : 2.3 - Proteins | (b) : 2.3 - Proteins | (c) : 9.1 - The gas exchange system | (d) : 6.1 - Structure of nucleic acids and replication of DNA

- NC(CS)C(=O)NCC(=O)O

Draw a circle around an R-group in the molecule shown in Fig. 2.1. [1]

- State the name of these covalent bonds.
- [1]

- Suggest **and** explain how mucin strands are transported out of the goblet cells.
-
-
-
-
-
-
-
-
- [3]

..... [2]

- ### Table 2.1

[illegible]

synthesised from the mutated <i>CFTR</i> allele													
---	--	--	--	--	--	--	--	--	--	--	--	--	--

(i) The difference between the DNA base sequence in row 1 and the DNA base sequence in row 2 of Table 2.1 is caused by a single gene mutation.

State the name of this type of gene mutation.

..... [1]

(ii) Row 1 and row 2 in Table 2.1 show the DNA strands used in the synthesis of RNA.

State the term used to describe the DNA strand that is used in the synthesis of RNA.

..... [1]

(iii) Complete Table 2.1 to show the missing bases in row 3. [1]

(iv) The normal *CFTR* allele is approximately 189 000 base pairs in length. The *CFTR* polypeptide consists of only 1480 amino acids.

Explain the reasons for this difference between the number of base pairs and the number of amino acids.

.....

.....

.....

.....

.....

.....

.....

..... [3]

Question No 11 - (9700_s23_21_1)

Subsection Topics: (a) : 1.2 - Cells as the basic units of living organisms | (b) : 2.3 - Proteins | (c) : 11.1 - The immune system

Fig. 1.1 is a transmission electron micrograph of a cell from the stem of sago pondweed, *Stuckenia pectinata*.

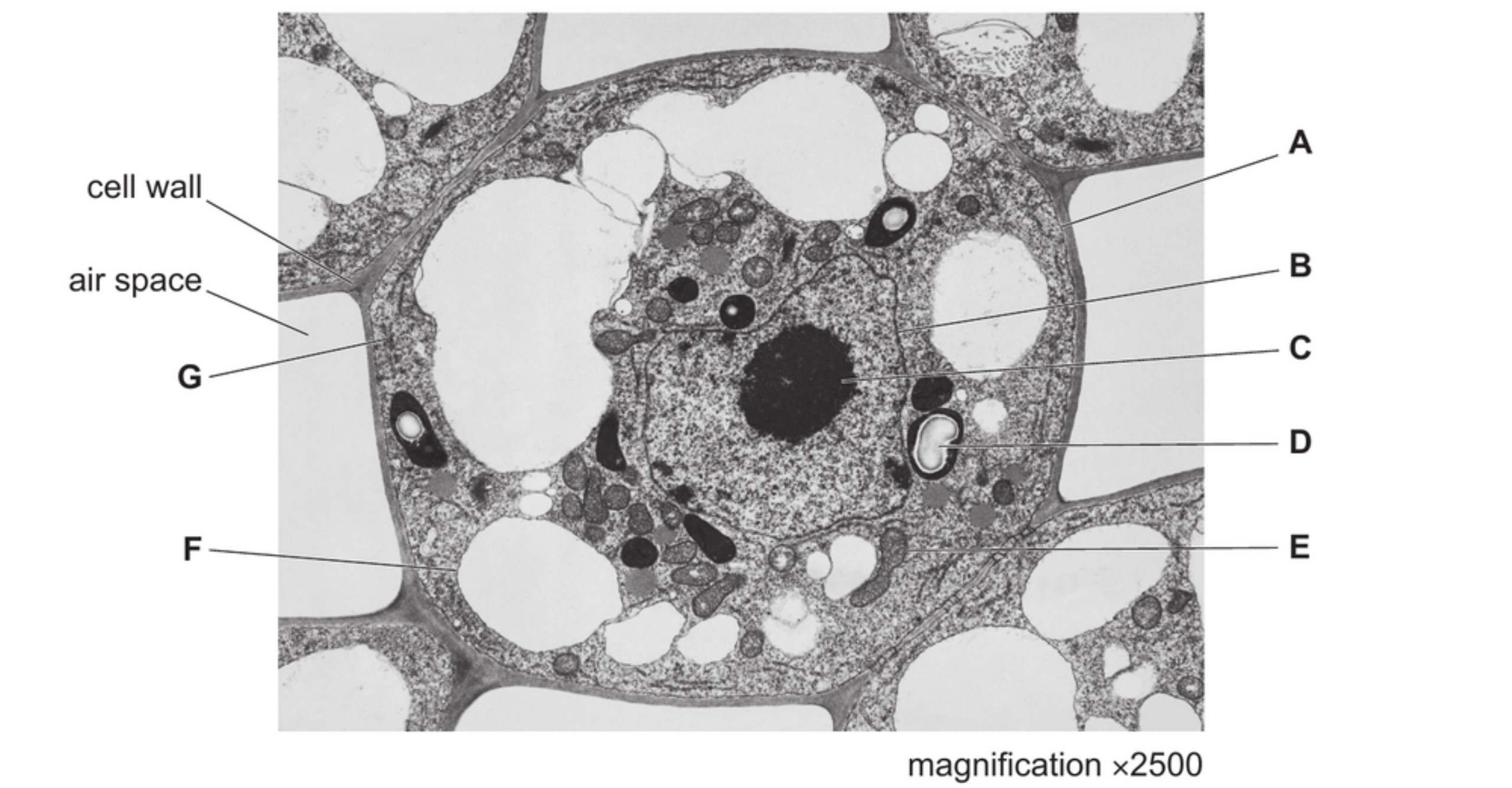


Fig. 1.1

- (a) (i) State the evidence from Fig. 1.1 that shows that the cell is from the stem of *S. pectinata* and **not** from the mesophyll of a leaf.
-
- [1]
- (ii) Complete each row in Table 1.1 to identify a cell structure shown in Fig. 1.1 that carries out the function listed.

Table 1.1

function	name of cell structure	letter on Fig. 1.1
gas exchange		
production of subunits of ribosomes		
active transport of ions		
aerobic respiration		

[4]

- (b) Plant vacuoles develop when vesicles fuse together. The vacuoles increase in size as more vesicles fuse.

Fig. 1.2 shows the movement of vesicles within a plant cell during the development of a vacuole.

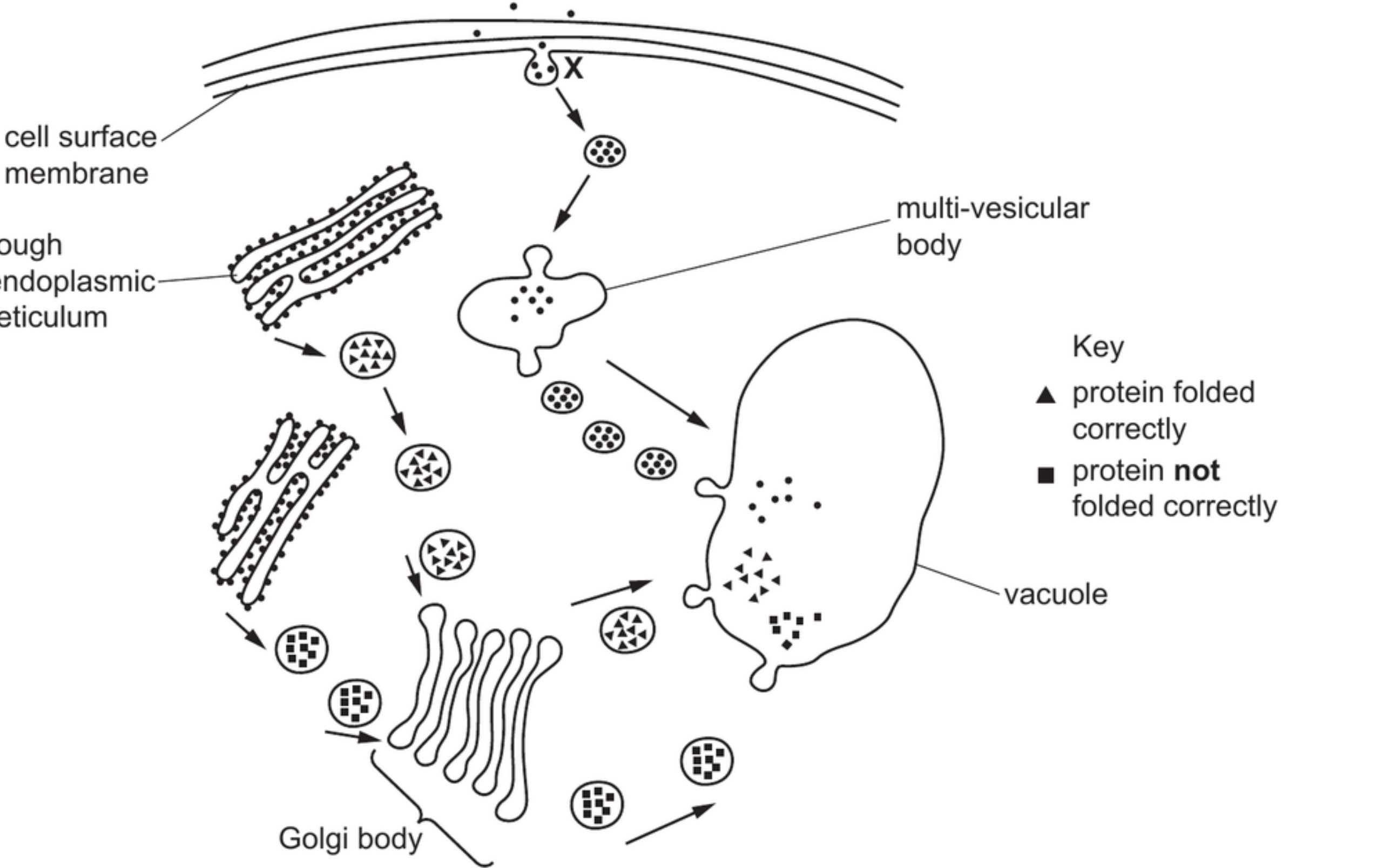


Fig. 1.2

(i) Name the process that is occurring at **X**.

..... [1]

(ii) Some of the vesicles formed by the Golgi body pass to the vacuole. These vesicles contain proteins that have been folded correctly and some that have **not** folded into their correct shapes. The proteins that have **not** folded correctly pass to the vacuole where they are broken down.

Explain how proteins that have **not** folded correctly are broken down in the vacuole.

.....
.....
.....
.....
.....
.....

(c) Small vacuoles in *S. pectinata* may have roles similar to lysosomes in animal cells.

Describe the role of lysosomes in animal cells in defence against pathogens.

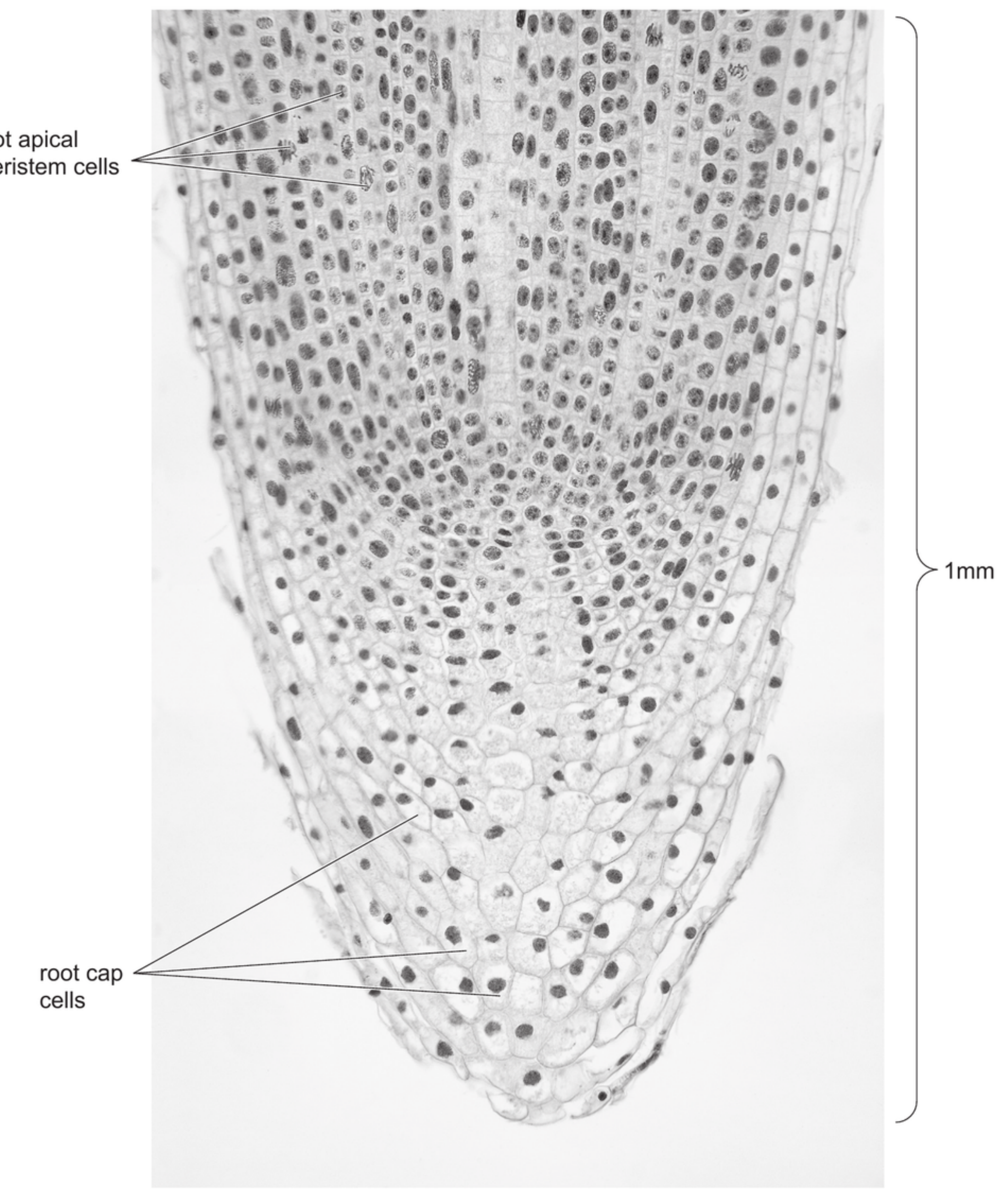
.....
.....
.....
.....
.....
..... [2]

Question No 12 - (9700_s23_22_2)
Subsection Topics: (a) : 7.2 - Transport mechanisms | (b) : 2.4 - Water | (c) : 3.1 - Mode of action of enzymes | (d) : 2.2 - Carbohydrates and lipids

Fig. 2.1 is a photomicrograph of a longitudinal section (LS) through a root tip. Two different regions are visible:

- the root apical meristem
- the root cap.

Cells in the root cap synthesise a gel-like, sticky secretion known as mucilage, which is important in reducing friction between soil and the growing root. It is composed mainly of polysaccharides and also contains some amino acids and enzymes.



(a) Describe **three** differences, **visible** in Fig. 2.1, between root apical meristem cells and root cap cells.

1

.....

.....

.....

2

.....

.....

.....

3

.....

.....

.....

[3]

(b) Mucilage acts as a glue to bind tiny soil particles together, forming small clumps close to the root. These small clumps help to maintain the soil water around the root tip and prevent the loss of water.

With reference to the cohesive **and** adhesive properties of water, suggest **and** explain how the formation of small clumps of soil helps to maintain the soil water around the root tip.

.....

.....

.....

.....

.....

.....

.....

.....

[3]

(c) Enzymes present in mucilage catalyse the breakdown of organic compounds in the soil. This increases the presence of mineral ions in the soil.

State the term used to describe enzymes that act **outside** the cells that synthesise them.

.....

[1]

(d) The polysaccharides and amino acids present in the mucilage are a source of nutrients for soil microorganisms that live in the area surrounding the root. Some of these microorganisms can break down soil compounds to release mineral ions.

(i) Explain what is meant by a polysaccharide.

.....

.....

.....

.....

..... [2]

(ii) The soil microorganisms use amino acids to synthesise proteins. All of the twenty different amino acids that are present in proteins have the same general structure.

Draw the general structure of an amino acid in the space provided **and** use this drawing to explain how it is possible to have many different amino acids.

.....

.....

(iii) Mineral ions are usually present in the soil in very low concentrations. The action of mucilage enzymes and soil microorganisms can help to increase the presence of mineral ions.

Root hair cells are specialised for the uptake of these mineral ions **and** for the absorption of water from the soil.

Suggest **and** explain how the presence of mineral ions in the root hair cell can **increase** the absorption of water by the root hair cells.

.....

.....

.....

.....

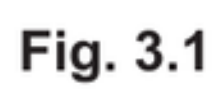
.....

.....

..... [3]

Subsection Topics: (a) : 1.2 - Cells as the basic units of living organisms | (b) : 8.2 - Transport of oxygen and carbon dioxide

(a) Fig. 3.1 is a photomicrograph showing different types of blood cell.



- Y

[2]

- Write down the formula you will use to make your calculation.

formula

magnification = x [2]

- [4]

[4]

- (ii) Sulfonamide is a competitive inhibitor of carbonic anhydrase.

Fig. 3.2 shows the effect of increasing substrate concentration on the rate of the reaction catalysed by carbonic anhydrase.

Sketch a curve **on Fig. 3.2** to show the effect of sulfonamide on the rate of reaction catalysed by carbonic anhydrase.

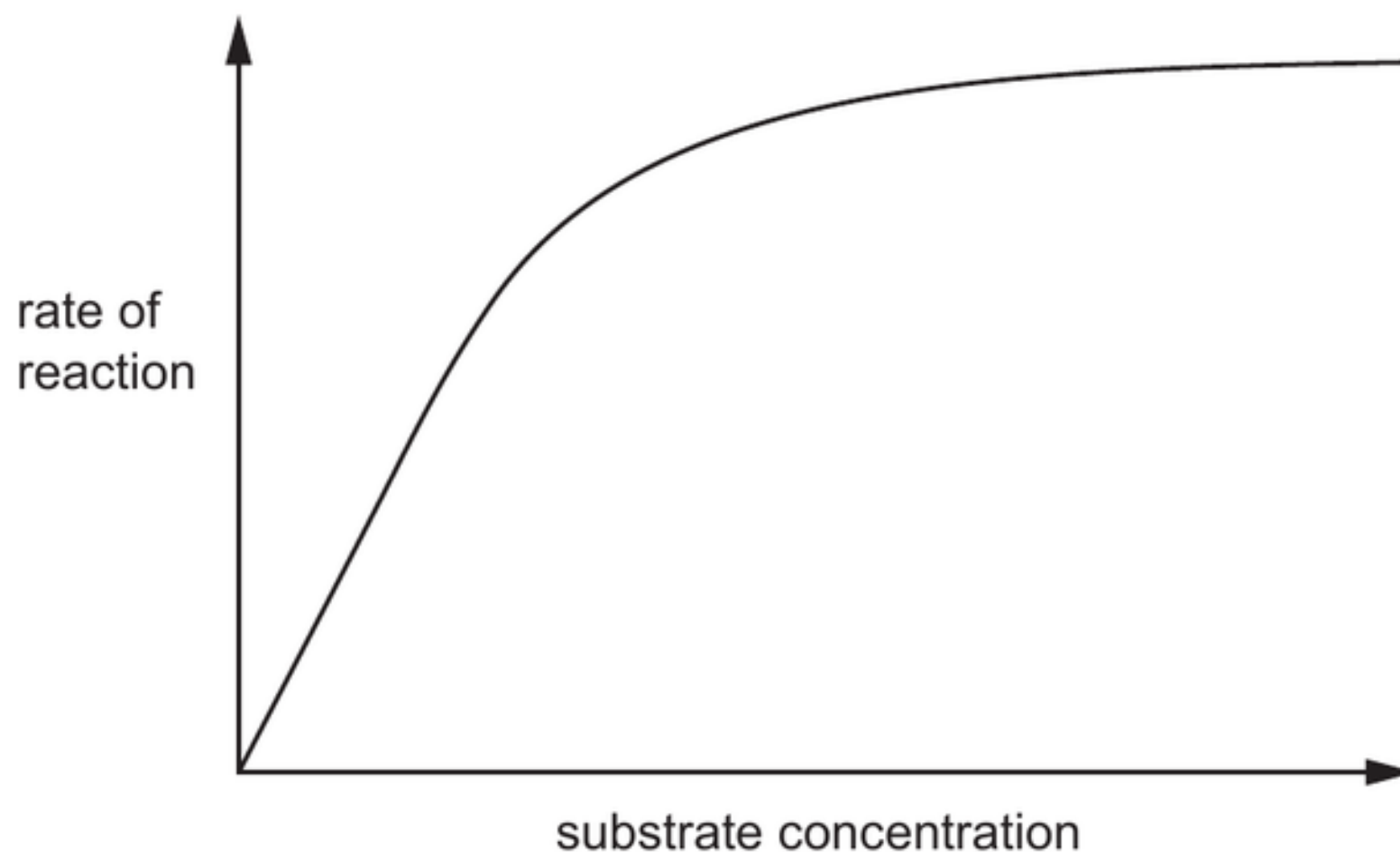


Fig. 3.2

[2]

[Total: 10]

Question No 14 - (9700_w23_21_6)

Subsection Topics: (a) : 5.1 - Replication and division of nuclei and cells, 6.1 - Structure of nucleic acids and replication of DNA | (b) : 3.1 - Mode of action of enzymes

(a) (i) State the name of the phase of the mitotic cell cycle during which DNA replication occurs.
..... [1]

(ii) During research, scientists can use modified nucleotides to prevent elongation of a polynucleotide chain during DNA replication.

Fig. 6.1 shows the structure of a DNA nucleotide found in the nucleus of a cell.

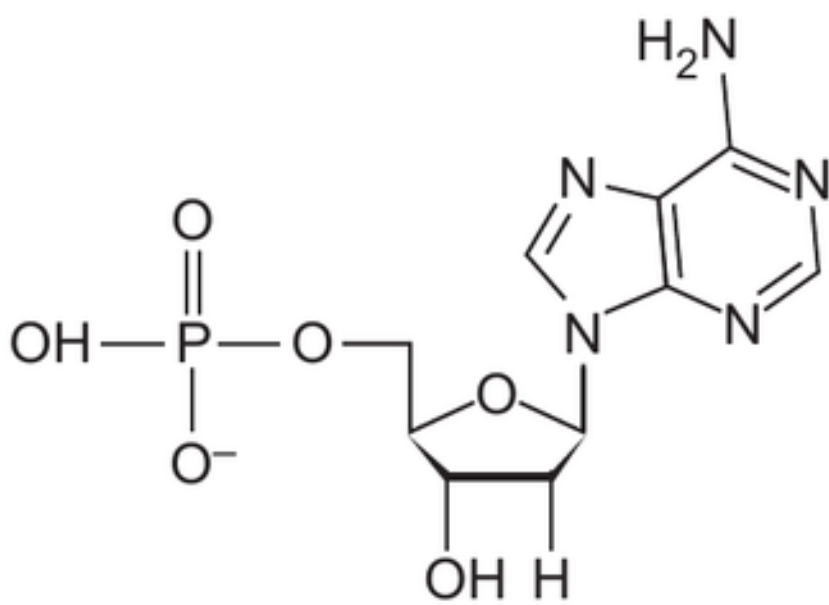


Fig. 6.1

Fig. 6.2 shows the structure of a modified nucleotide.

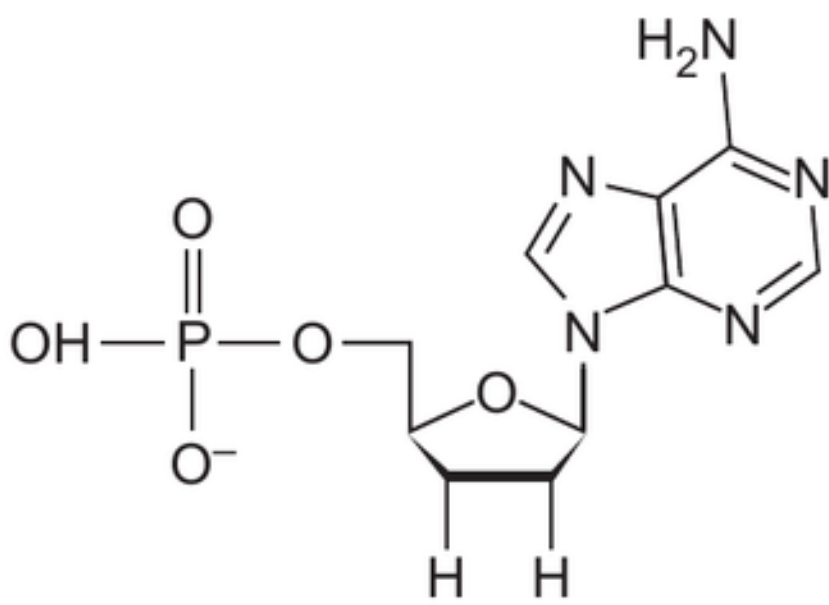


Fig. 6.2

Suggest how the structure of the modified nucleotide prevents DNA polymerase joining it to another nucleotide.

.....
.....
.....
.....
..... [2]

(b) RNA aptamers are short, single-stranded RNA molecules that can be used to study some infectious diseases

Scientists studying an infectious disease in animals investigated the effect of RNA aptamers on the activity of RNA polymerase that is produced by the pathogen.

The aptamers bind to a specific region of the RNA polymerase.

Table 6.1 shows the effect of two aptamers, F47 and F52, on the activity of RNA polymerase produced by the pathogen.

Table 6.1

aptamer present	V_{max} of RNA polymerase /arbitrary units	K_{m} of RNA polymerase /arbitrary units
none	1664	346
F47	1072	508
F52	1467	523

- (i) With reference to Table 6.1, compare the effect of the aptamers on the affinity of RNA polymerase for its substrate.

.....

.....

.....

..... [2]

- (ii) With reference to Table 6.1, suggest explanations for the effect of the presence of an aptamer on the rate of transcription catalysed by the RNA polymerase.

Question No 15 - (9700_w23_22_2)
Subsection Topics: (a) : 2.3 - Proteins | (b) : 2.3 - Proteins | (c) : 2.3 - Proteins | (d) : 3.2 - Factors that affect enzyme action | (e) : 3.2 - Factors that affect enzyme action

Keratin is the structural protein in feathers of birds. Keratin polypeptides are composed of a high proportion of cysteine amino acids, which have sulfur-containing R groups.

Keratin polypeptides form filaments. The two main types of keratin in feathers are α -keratin, which consists of many α -helices, and β -keratin, consisting of many β -pleated sheets.

(a) Keratin can be classified as α -keratin or β -keratin based on a study of protein structure.

Suggest the level of protein structure used to classify a protein as α -keratin or β -keratin.

..... [1]

(b) Protease enzymes hydrolyse proteins. Many proteases are able to hydrolyse more than one type of protein.

Suggest why it is possible for a protease to act on different types of protein.

.....

.....

..... [1]

(c) Proteases known as keratinases vary in the extent to which they can hydrolyse keratin.

Feathers are not easily degraded (broken down) because keratin is a very stable protein.

Suggest features of keratin structure that contribute to its stability.

.....

.....

.....

.....

.....

.....

.....

..... [3]

Keratinases are used to degrade the large quantities of waste feathers from chickens and turkeys that are processed in the food industry. The products of feather degradation can be used in animal feed.

Scientists investigated whether three different keratinases, K12, A22 and P3, were suitable as industrial enzymes. These enzymes were extracted from three different soil bacteria.

The effects of temperature and pH on the activity of each keratinase were investigated.

The results are shown in Fig. 2.1 and Fig. 2.2.

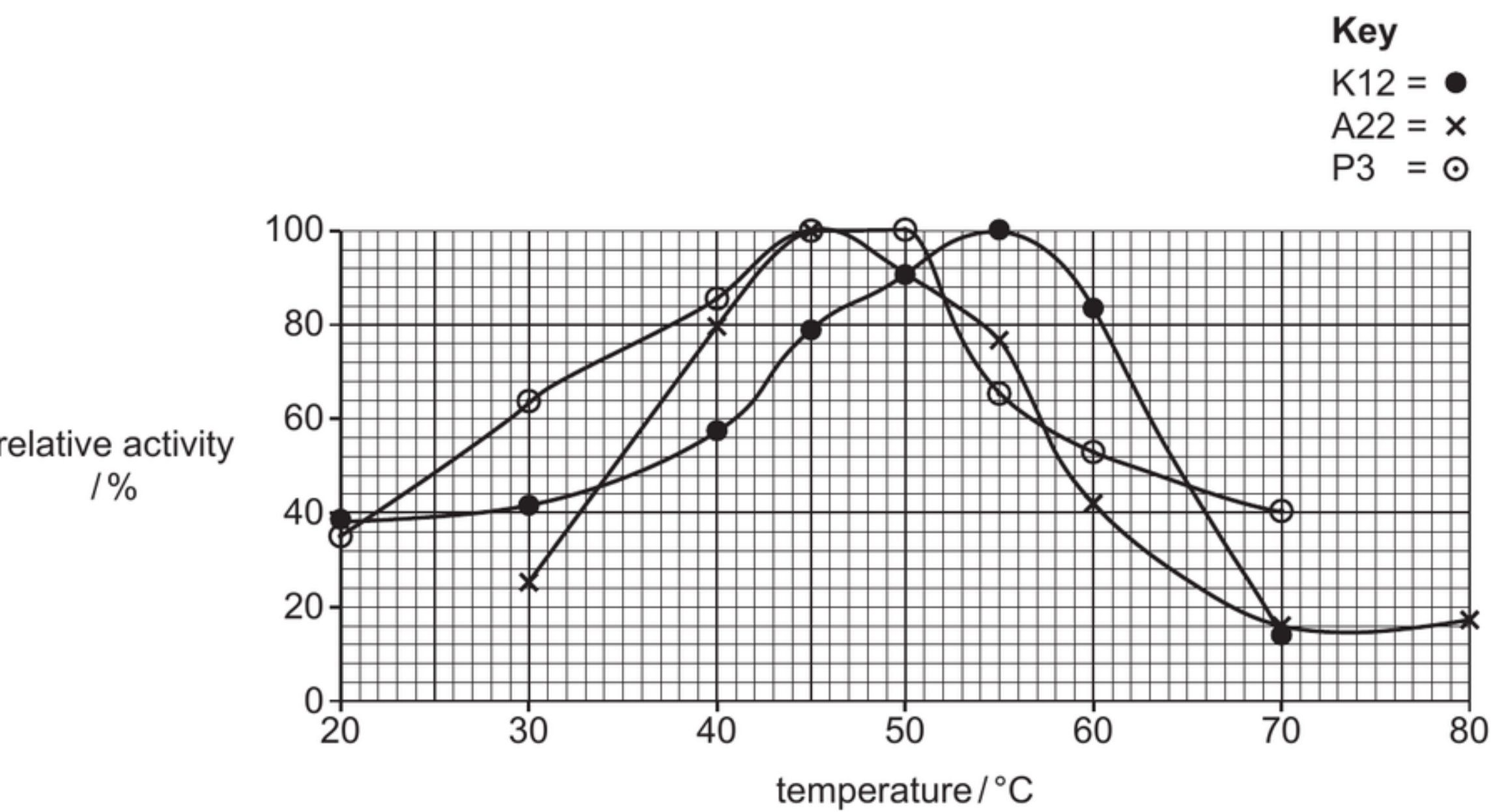


Fig. 2.1

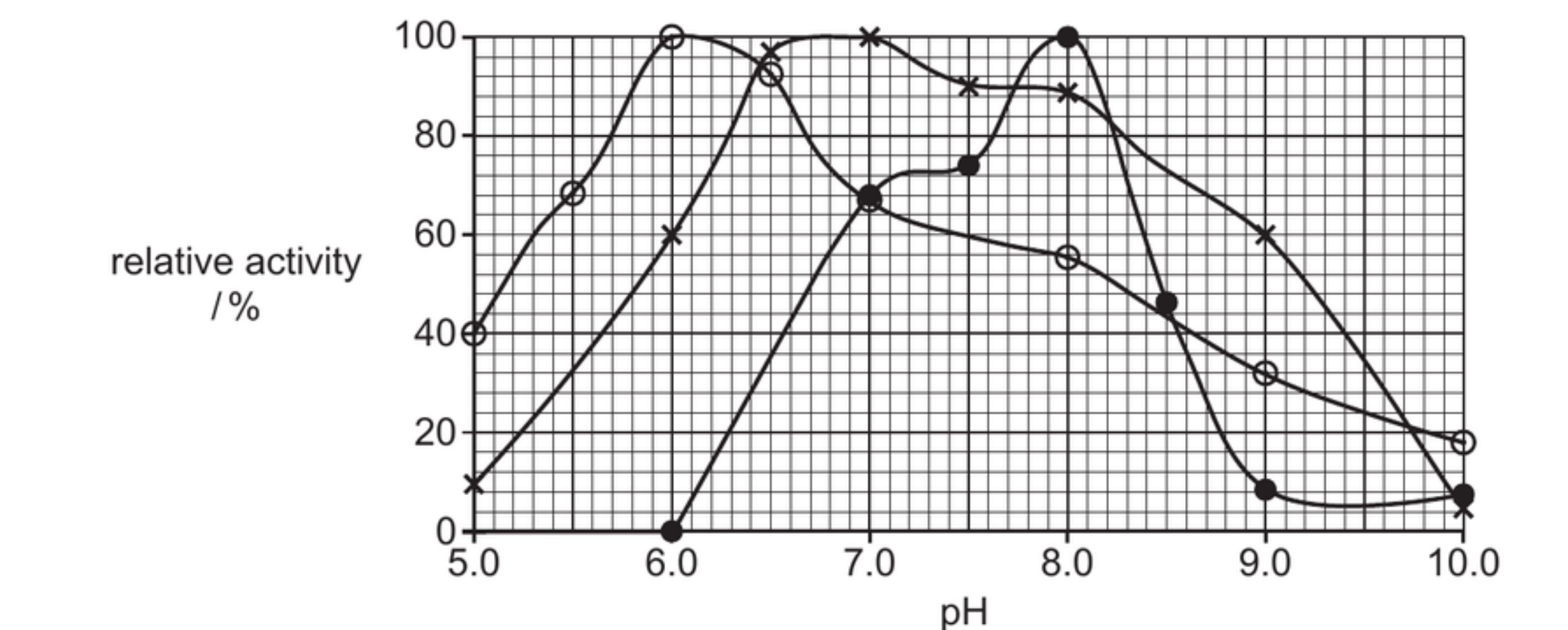


Fig. 2.2

(d) To degrade feather waste from industry, it is an advantage to use keratinases that show at least 60% relative activity in conditions where temperature and pH can vary widely.

Table 2.1 shows, for each keratinase, the working range of temperature and pH where at least 60% relative activity is obtained.

Question No 16 - (9700_w23_23_2)

Subsection Topics: (a) : 3.1 - Mode of action of enzymes | (b) : 3.1 - Mode of action of enzymes

Glucose is used in the synthesis of amylose. Glucose is first converted to glucose 1-phosphate (G 1-P).

Starch phosphorylase is an intracellular enzyme that can catalyse the synthesis of amylose from G 1-P, which is the substrate for the reaction:



n = a large number

Students used a colorimeter to investigate the progress of the reaction.

The students made a reaction mixture containing 0.01 mol dm⁻³ G 1-P in a buffer solution at pH 6.0. A very small quantity of amylose was added to initiate the reaction.

A solution of starch phosphorylase was added to the reaction mixture and samples were taken at 1-minute intervals. Each sample was added to a dilute iodine solution, stirred and then poured into a cuvette. The absorbance of each solution was recorded.

The results of the investigation are shown in Fig. 2.1.

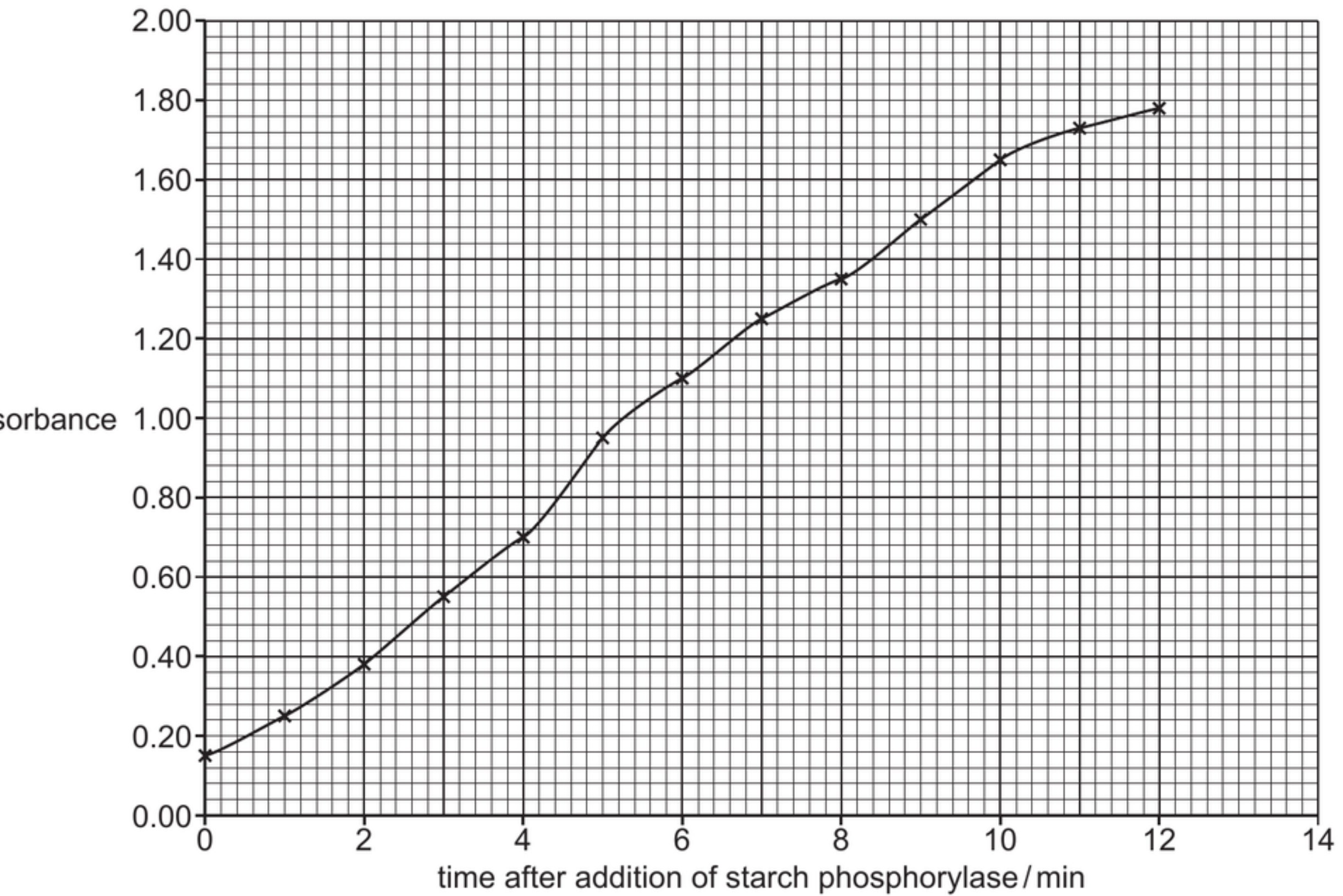


Fig. 2.1

(a) (i) Explain why the absorbance increases, as shown in Fig. 2.1.

.....
.....

(ii) The students took their final sample at 12 minutes.

Predict the results for absorbance if the students had continued to take samples for a further 10 minutes. Explain your answer.

prediction
.....
.....

explanation

.....
..... [2]

(iii) State an advantage of using a colorimeter in determining the progress of the reaction.

.....
.....
.....
..... [1]

(b) The reaction catalysed by starch phosphorylase occurs at the ends of amylose molecules.

Describe the sequence of events that occurs when starch phosphorylase catalyses the addition of a molecule of glucose to the end of an amylose molecule.

.....
.....
.....
.....
.....
.....
.....
.....
..... [4]

[Total: 8]

Question No 17 - (9700_m22_22_3)
Subsection Topics: (a) : 2.3 - Proteins | (b) : 3.2 - Factors that affect enzyme action | (c) : 3.2 - Factors that affect enzyme action

(a) Enzymes are polymers of amino acids.

Complete Fig. 3.1 to show the general structure of an amino acid.

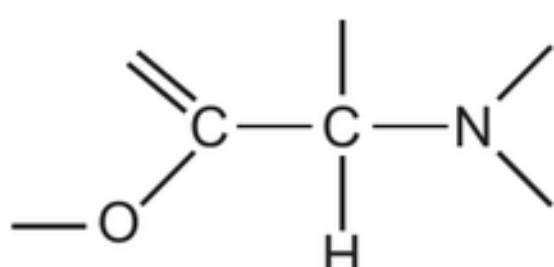


Fig. 3.1

[1]

(b) When bananas are peeled, the exposed tissue gradually turns brown in the presence of oxygen in the air. This is due to an enzyme called catechol oxidase, which acts on the substrate catechol. Catechol and catechol oxidase are present in the banana tissue.

The overall reaction is shown in Fig. 3.2.

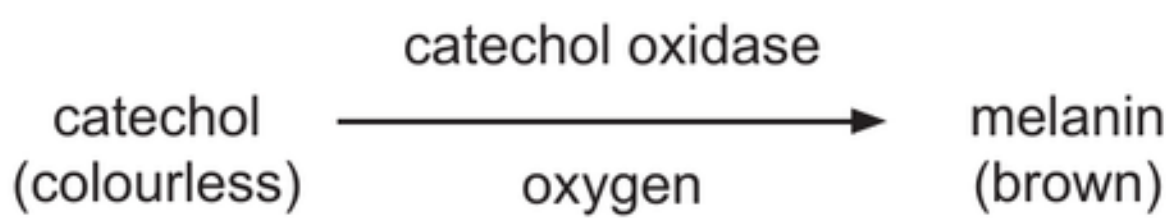


Fig. 3.2

A student investigated how the concentration of catechol oxidase affects the rate of this reaction. All other variables were kept constant throughout the investigation.

For each concentration of catechol oxidase used, the student mixed catechol oxidase solution with catechol and recorded the time taken for the mixture to reach a standard brown colour.

The rate of reaction, **R**, for each concentration of catechol oxidase used was then calculated using the formula:

$$R = \frac{1}{\text{time to reach standard brown colour in minutes}}$$

(i) Calculate the rate of reaction when the standard brown colour was reached in 2 minutes 30 seconds.

rate of reaction = min⁻¹ [1]

(ii) Fig. 3.3 is a graph showing the results of the investigation.

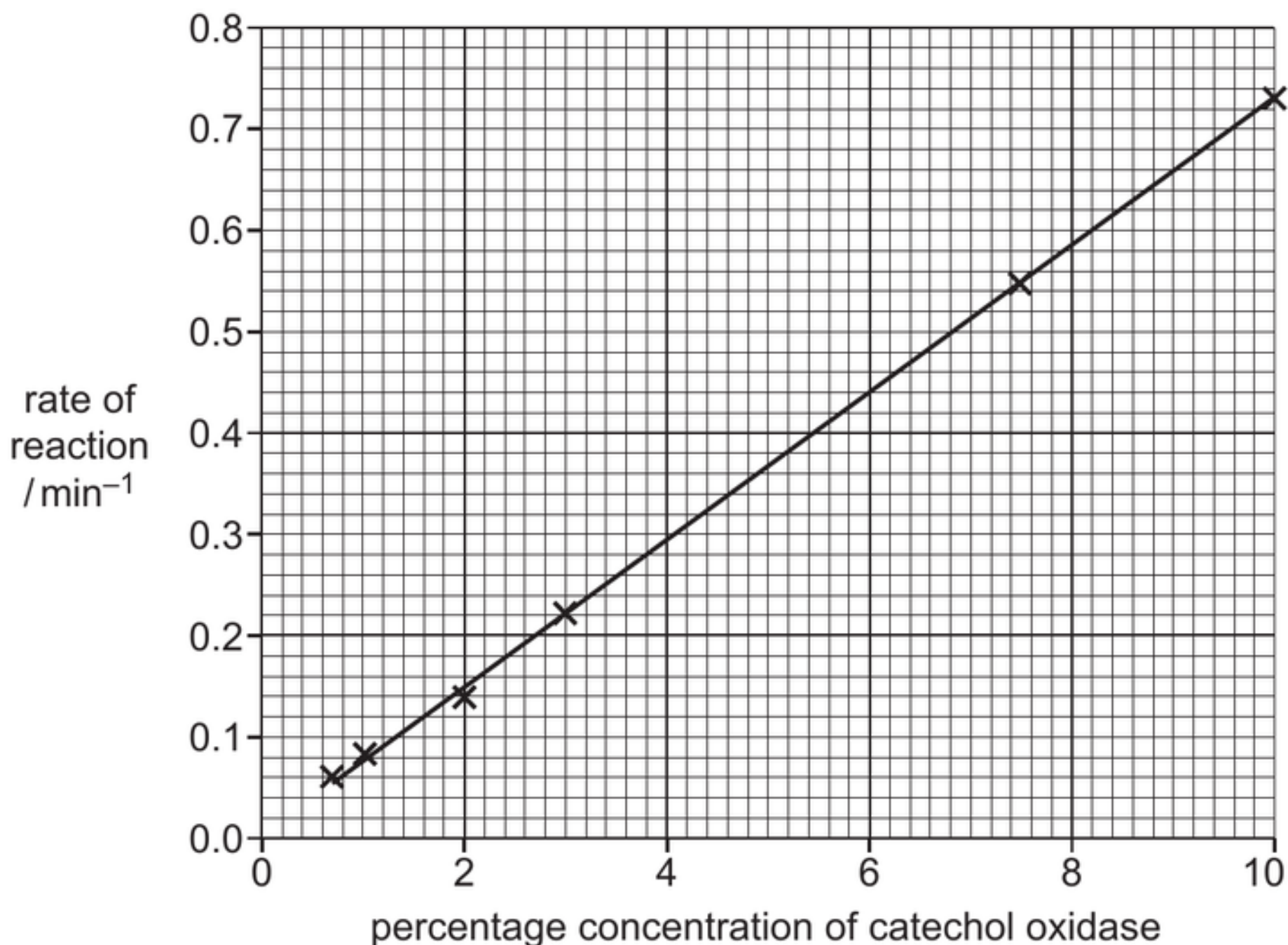


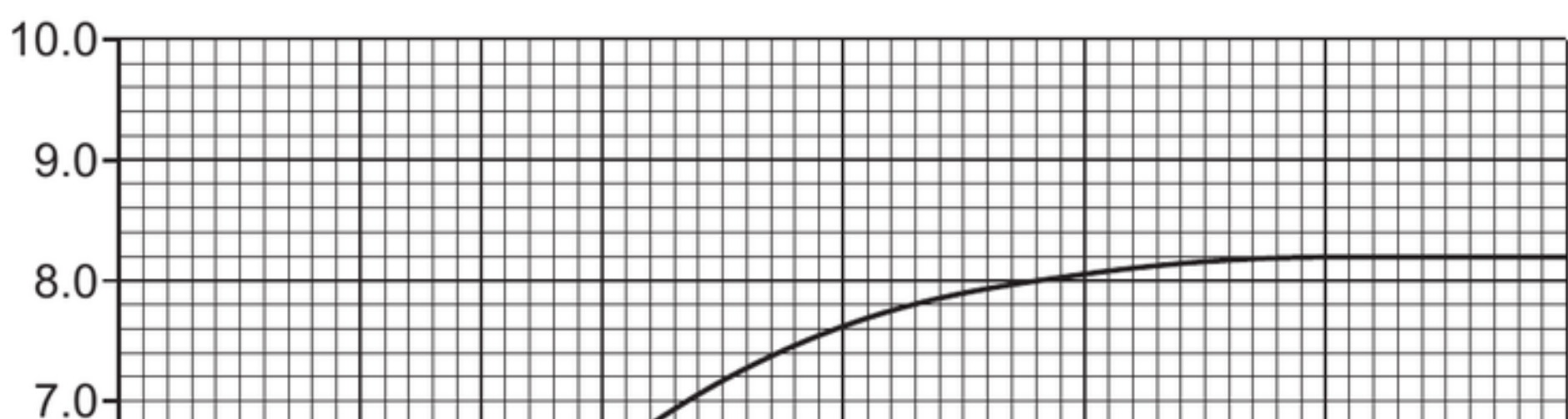
Fig. 3.3

State how the results shown in Fig. 3.3 show that substrate was in excess at all concentrations of catechol oxidase tested.

.....
.....
..... [1]

(c) The student carried out a further experiment to investigate how the concentration of catechol affects the initial rate of reaction. All other variables were kept constant throughout this investigation.

Fig. 3.4 is a graph showing the effect of varying the concentration of catechol on the initial rate of reaction.



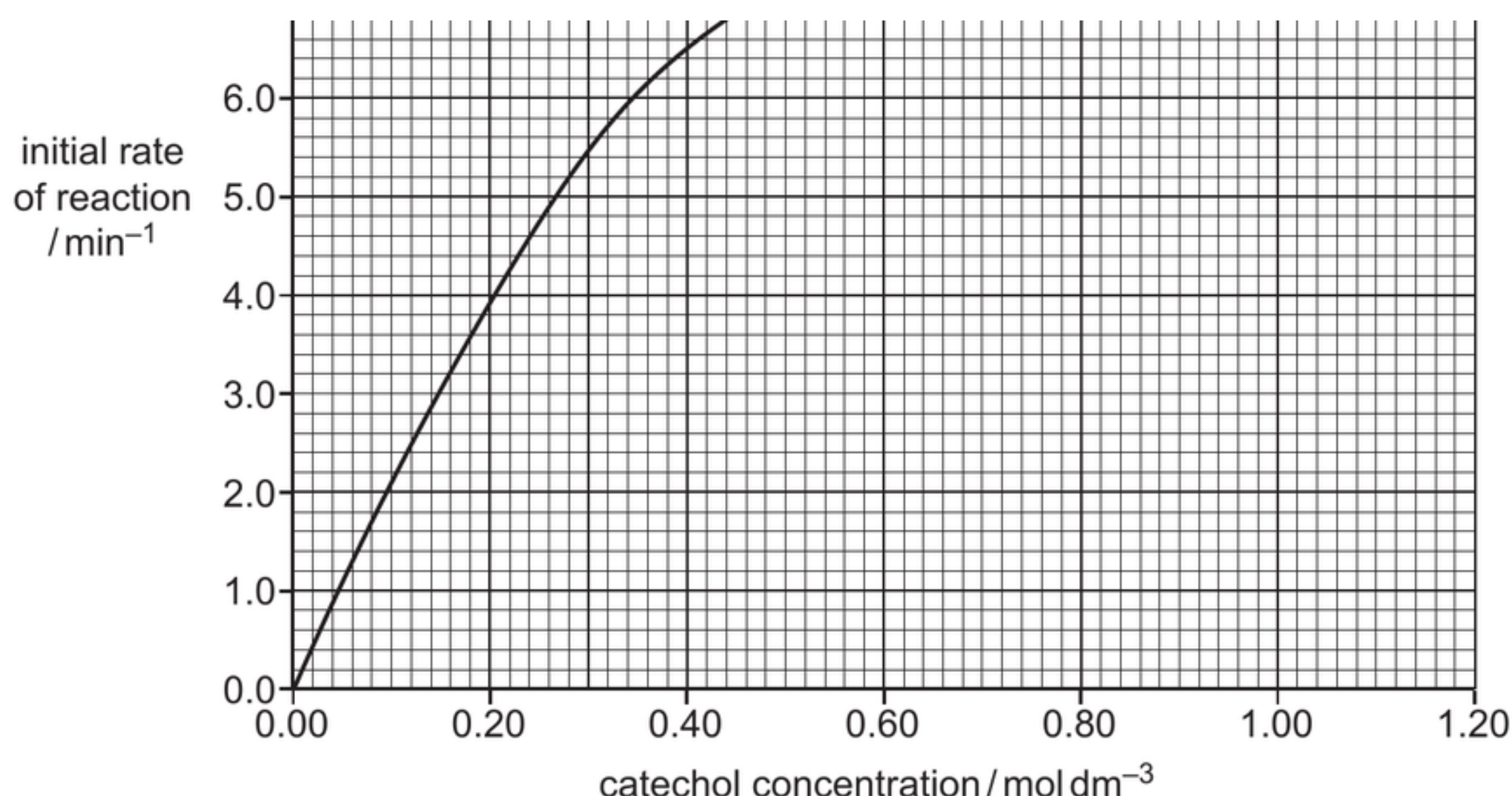


Fig. 3.4

- (i) Explain the shape of the curve shown in Fig. 3.4.

.....

.....

.....

.....

.....

.....

..... [3]

- (ii) Use Fig. 3.4 to calculate the value of the Michaelis–Menten constant (K_m) for the reaction between catechol oxidase and catechol.

$K_m = \dots\dots\dots \text{mol dm}^{-3}$ [1]

- (iii) Methylcatechol has a similar shape to catechol. Catechol oxidase can also use methylcatechol as a substrate.

The K_m value for the reaction using methylcatechol as the substrate was found to be much lower than the K_m value for the reaction using catechol as the substrate, when the reactions were carried out under the same conditions.

State what these K_m values indicate about the relationship between the enzyme and the two substrates.

.....

.....

..... [1]

Question No 18 - (9700_s22_21_3)

Subsection Topics: (a) : 3.1 - Mode of action of enzymes | (b) : 3.2 - Factors that affect enzyme action | (c) : 3.2 - Factors that affect enzyme action

A tyrosine kinase receptor (TKR) is a protein complex found in the cell surface membrane of mammalian cells.

TKR has two components involved in the process of cell signalling:

- a receptor for the signalling molecule (ligand)
- an enzyme that catalyses the transfer of a phosphate group from ATP to an intracellular protein.

Fig. 3.1 is a diagram to show how TKR is involved in cell signalling.

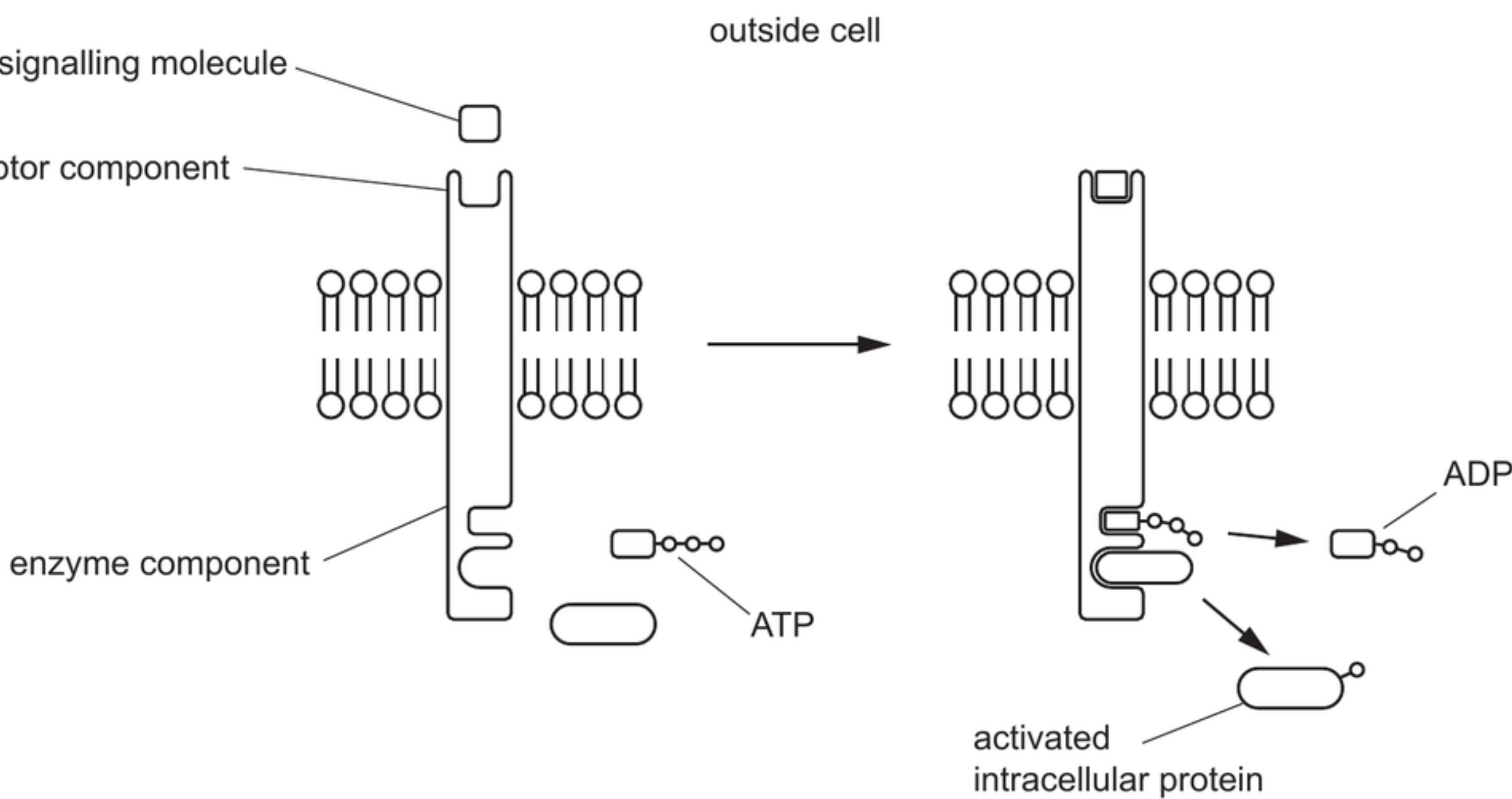


Fig. 3.1

(a) Most enzymes are specific to one reaction.

With reference to Fig. 3.1, explain how the structure of an enzyme provides its specificity.

.....

.....

.....

.....

.....

..... [2]

The drug GNF-5 is used in the treatment of some cancers. GNF-5 affects the activity of TKR by binding to the enzyme component of the complex.

Researchers investigated the effect of GNF-5 on the activity of TKR using different concentrations of ATP solution. In an experiment the activity of TKR was measured with no GNF-5 **and** with GNF-5.

The results are shown in Fig. 3.2.

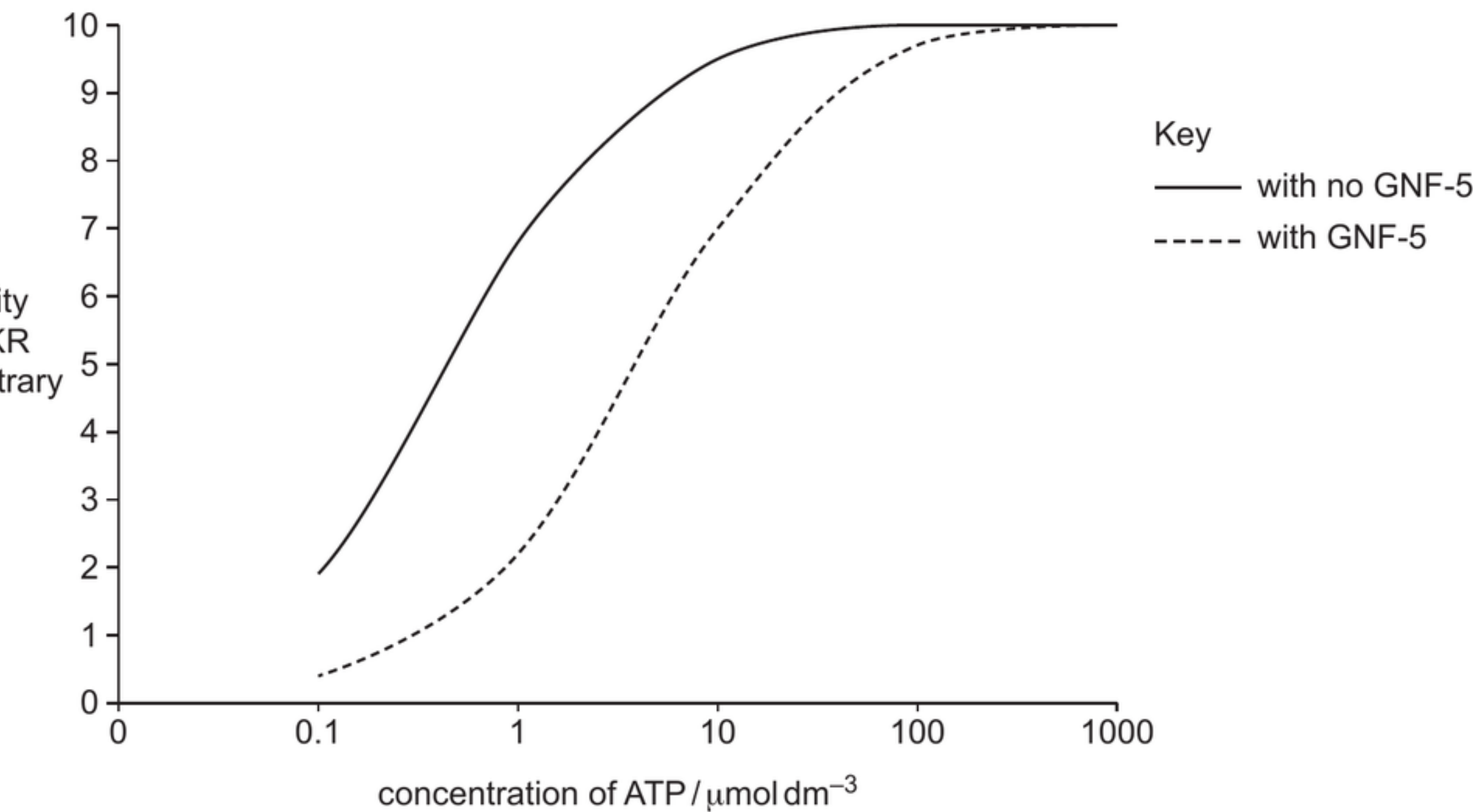


Fig. 3.2

(b) The researchers concluded that GNF-5 acts as an inhibitor of the enzyme component of TKR **and** that it is a competitive inhibitor.

Use Fig. 3.2 to provide evidence for these conclusions.

.....

.....

.....

.....

.....

.....

..... [3]

(c) A mutation of the gene coding for TKR results in changes to the enzyme component of TKR. This altered form of TKR is known as T315L.

The effect of GNF-5 on the activity of T315L was also investigated.

The results of this investigation are shown in Fig. 3.3.

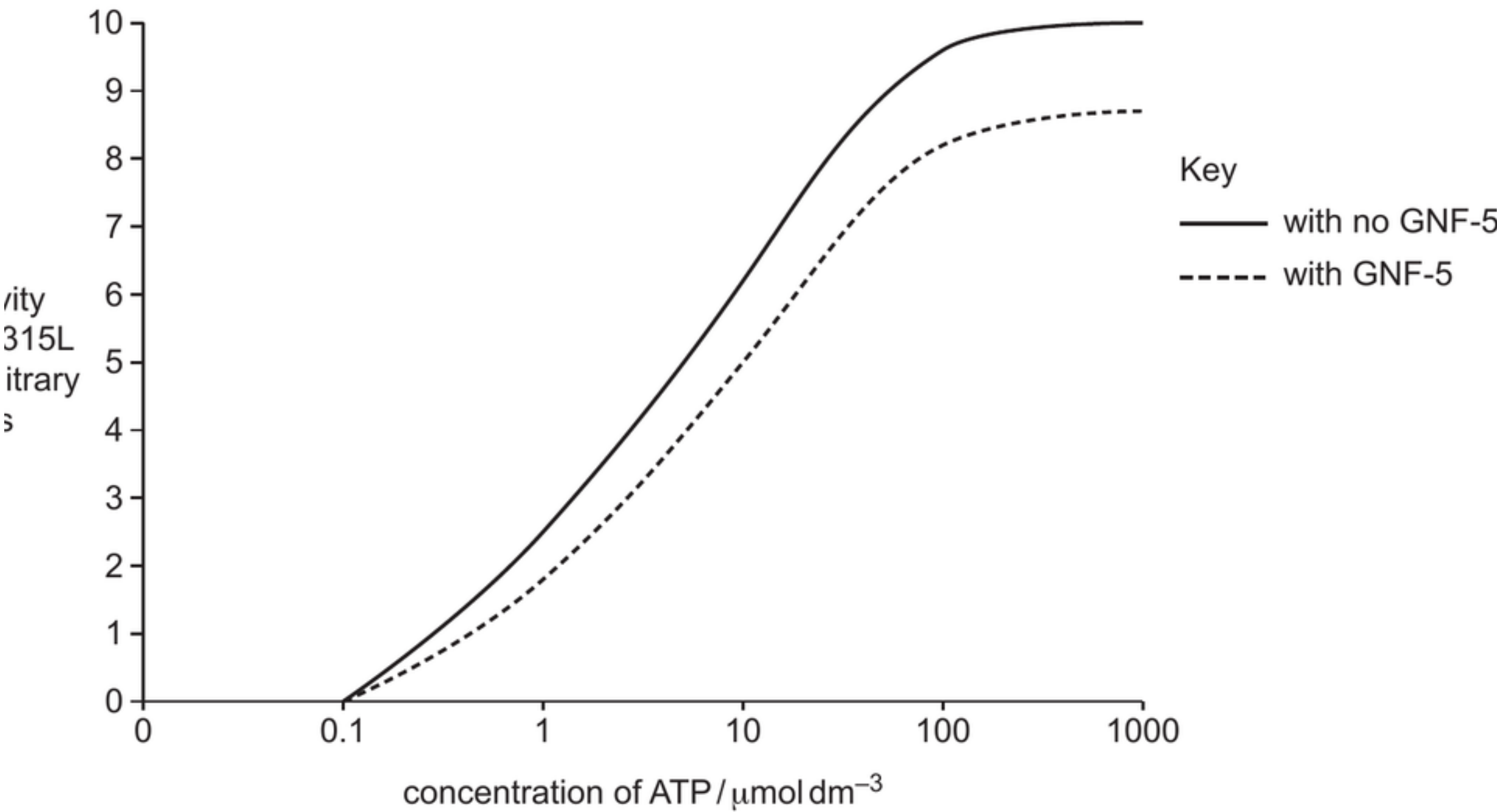


Fig. 3.3

Use Fig. 3.2 and Fig. 3.3 to:

(i) State how the activity of T315L differs from TKR when **no** GNF-5 was present.

.....
.....
..... [1]

(ii) State how the effect of GNF-5 on T315L differs from the effect of GNF-5 on TKR.

Question No 19 - (9700_s22_22_4)

Subsection Topics: (a) : 8.2 - Transport of oxygen and carbon dioxide | (b) : 3.1 - Mode of action of enzymes
| (c) : 6.1 - Structure of nucleic acids and replication of DNA | (d) : 8.2 - Transport of oxygen and carbon
dioxide | (e) : 7.2 - Transport mechanisms | (f) : 3.2 - Factors that affect enzyme action

The enzyme carbonic anhydrase has been found in a wide range of organisms and acts as a catalyst in many tissues.

Studies have shown that there are differences in the protein structure of the enzyme and differences in the number and organisation of introns and exons of the gene coding for the enzyme.

All carbonic anhydrase enzymes catalyse the same reversible reaction, shown in Fig. 4.1.

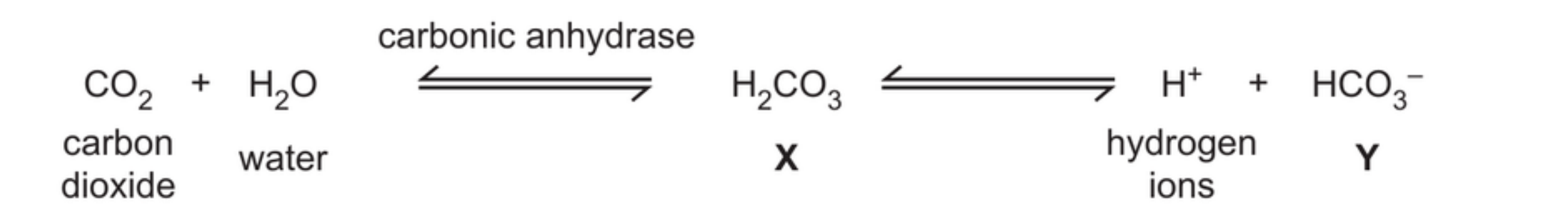


Fig. 4.1

(a) With reference to Fig. 4.1, name **X** and **Y**.

X

Y [2]

(b) Carbonic anhydrase enzymes can have different primary structures.

Suggest how all carbonic anhydrase enzymes can catalyse the same reaction, even though they have different primary structures.

.....

.....

..... [1]

(c) Genes coding for proteins in eukaryotes consist of introns and exons.

Outline the similarities and differences between the introns and the exons of genes coding for proteins such as carbonic anhydrase.

.....

.....

.....

.....

.....

.....

.....

.....

..... [3]

All mammals have the same type of carbonic anhydrase, known as α -carbonic anhydrase. Many different forms, or isoforms, of α -carbonic anhydrase have been identified in mammals.

There are 15 isoforms of α -carbonic anhydrase (CA) in humans. Cells of different tissues have one or more isoforms. Within cells the isoforms may be in different locations.

(d) Red blood cells contain two isoforms, CA1 and CA2.

Suggest the location of CA1 and CA2 in red blood cells **and** give a reason for your answer.

.....

.....

.....

.....

..... [2]

(e) Isoform CA6 forms part of human breast milk. Mammary gland cells package CA6 in Golgi vesicles for release from the cells.

Name the transport mechanism associated with CA6 secretion.

..... [1]

- (f) Human CA isoforms in some epithelial cells in the eye have a role in the formation of the clear fluid of the eye known as aqueous humour. Overactivity of the enzyme may lead to a harmful increase of pressure within the eye and cause a condition known as glaucoma.

Acetazolamide is a therapeutic drug that can be used in the treatment of glaucoma. It acts as a reversible non-competitive inhibitor.

Describe the mechanism of action of acetazolamide as a reversible non-competitive inhibitor of carbonic anhydrase.

.....
.....
.....
.....
.....
.....
.....
.....
..... [3]

Question No 20 - (9700_s22_23_5)

Subsection Topics: (a) : 4.1 - Fluid mosaic membranes | (b) : 3.2 - Factors that affect enzyme action | (c) : 6.1 - Structure of nucleic acids and replication of DNA | (d) : 4.1 - Fluid mosaic membranes

Arachidonic acid is a fatty acid that is a common component of phospholipids.

Phospholipids can be used as a source of arachidonic acid when it is metabolised within cells in an enzyme-catalysed pathway known as the cyclooxygenase (COX) pathway.

The final products of the COX pathway can be different in different cell types, causing a range of responses. In some cells, the products are involved in the inflammatory response, which is a response by the body to infection. In other cells, cell division is stimulated.

Fig. 5.1 shows the **first reaction** in the COX pathway. This reaction is catalysed by an enzyme known as COX-2.

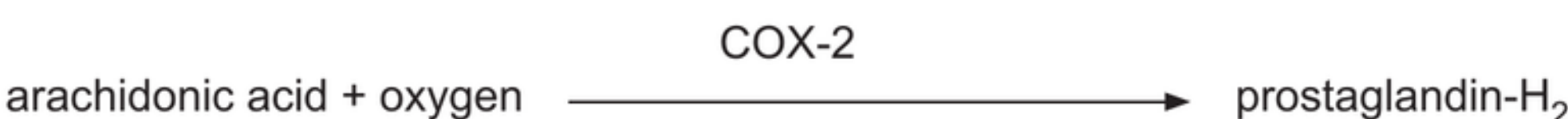


Fig. 5.1

- (a) The enzymes involved in the COX pathway are located in the membrane of rough endoplasmic reticulum.

Suggest the advantages to the cell of enzyme pathways being located in cell membranes, rather than in the cytosol of the cell (fluid portion of cytoplasm).

.....

.....

.....

..... [2]

- (b) During an inflammatory response, compounds produced by the COX pathway cause an increased sensitivity to pain.

Some anti-inflammatory drugs are reversible competitive inhibitors of COX-2.

Fig. 5.2 shows how increasing arachidonic acid concentration affects COX-2 activity.

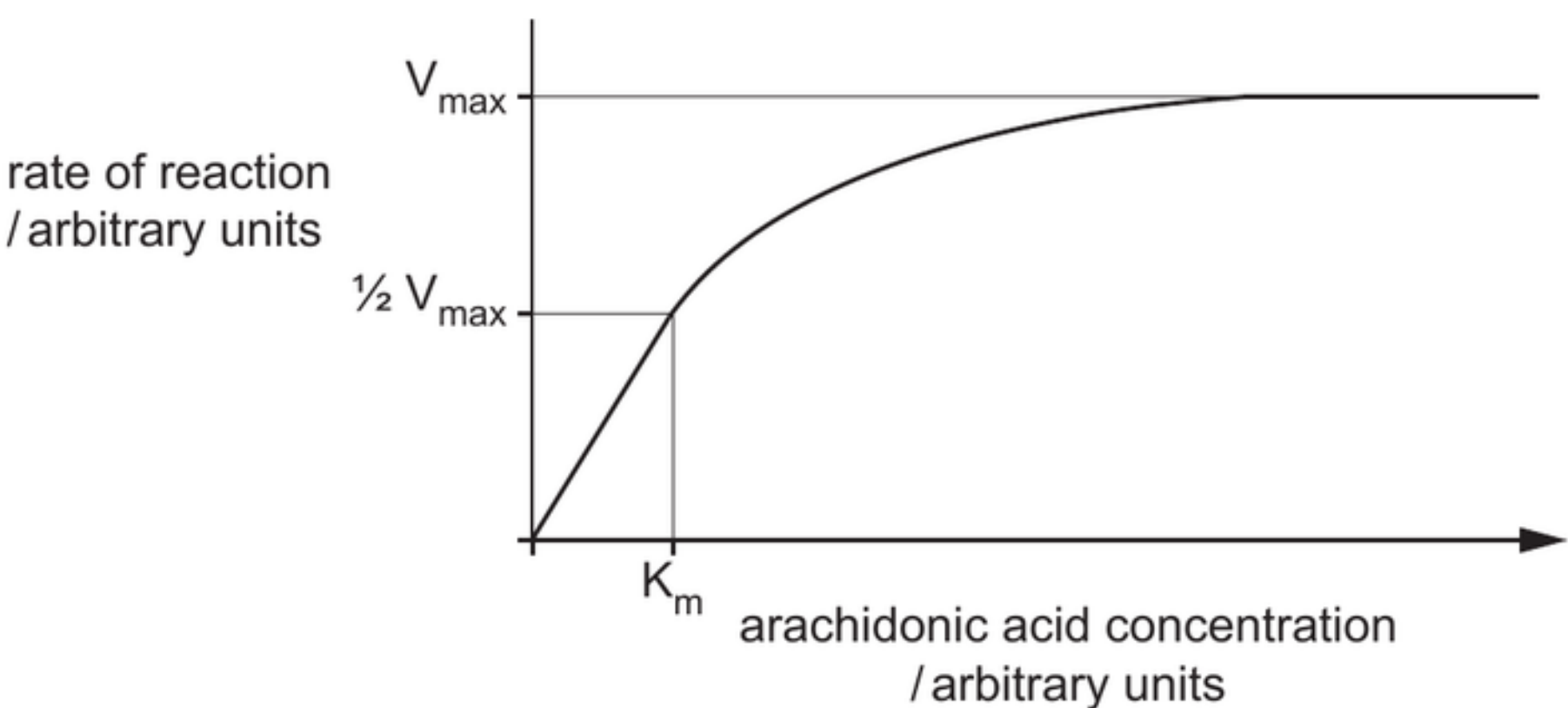


Fig. 5.2

- (i) Sketch on Fig. 5.2 the curve obtained if an anti-inflammatory drug, which is a **competitive** inhibitor, is present with arachidonic acid. [1]
- (ii) Complete the statements to show whether the maximum rate of reaction (V_{max}) and the Michaelis-Menten constant (K_m) of COX-2 **increases**, **decreases**, or **stays the same** in the presence of a competitive inhibitor.

In the presence of a competitive inhibitor:

V_{max} of COX-2

K_m of COX-2 [2]

- (c) COX-2 is composed of two identical polypeptides. The enzyme is produced when a gene, *PTGS2*, located on chromosome 1, is switched on and transcription begins.

- (i) Using gene *PTGS2* and enzyme COX-2 as examples, explain what is meant by a gene.
-
-
-
- [2]

- (ii) Some mutations in *PTGS2* lead to an increased rate of transcription. These mutations have been linked to an increased risk of certain types of cancer.

Suggest why mutations in *PTGS2* may increase the risk of cancer.

.....

.....

.....

..... [2]

(d) Fig. 5.3 shows the molecular structure of arachidonic acid. Not all hydrogen atoms are shown.

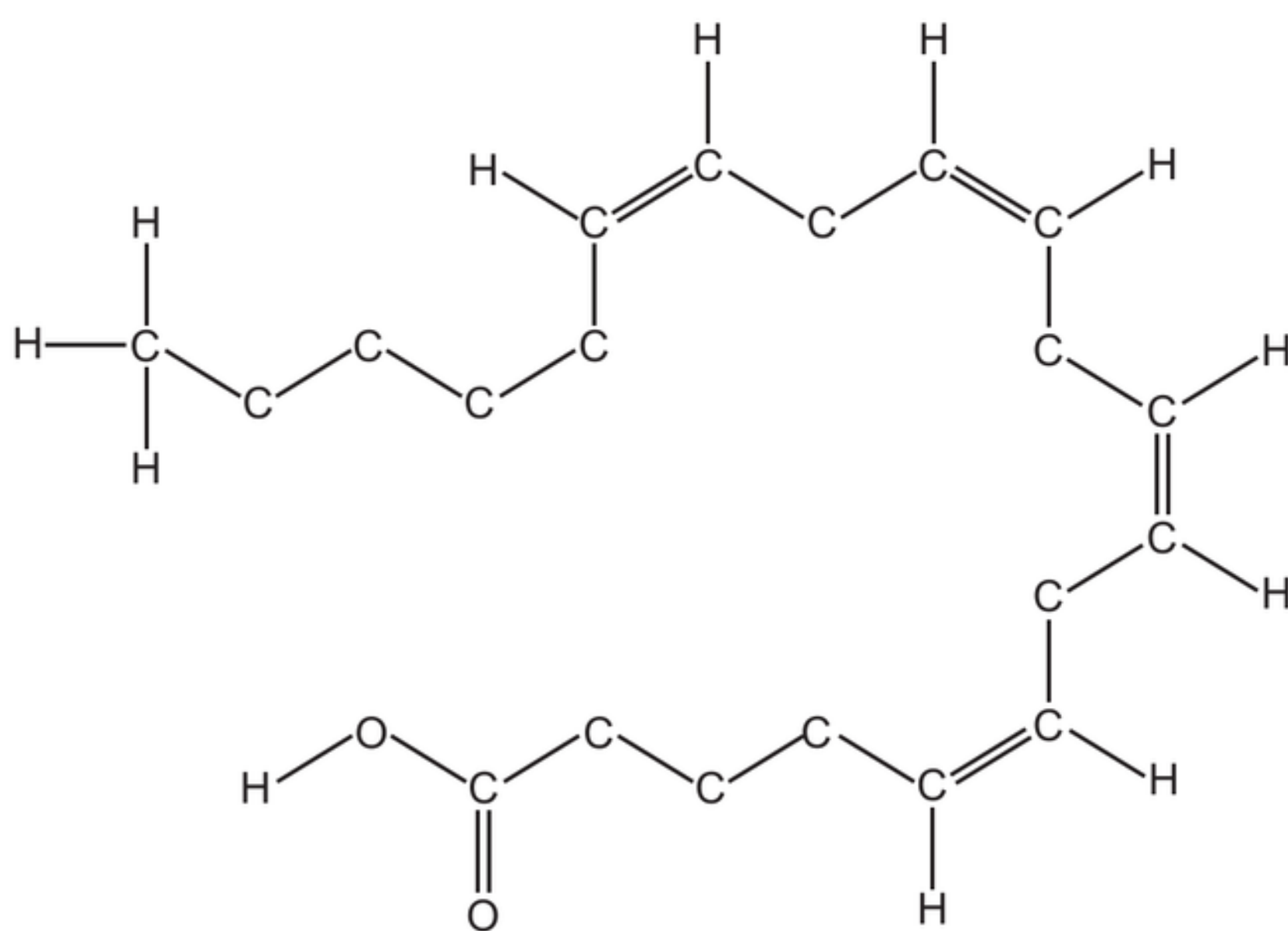


Fig. 5.3

With reference to Fig. 5.3, explain why increasing the proportion of phospholipids with arachidonic acid in a cell will increase the fluidity of the cell surface membrane of the cell.

[3]

Question No 21 - (9700_w22_21_4)
Subsection Topics: (a) : 10.1 - Infectious diseases | (b) : 11.1 - The immune system | (c) : 3.1 - Mode of action of enzymes

- (a) Scientists have produced structures known as virosomes, which are used in certain vaccines. Virosomes do **not** cause disease.

Fig. 4.1 is a diagram of a section through a virosome used in some vaccinations to protect against the virus which causes influenza.

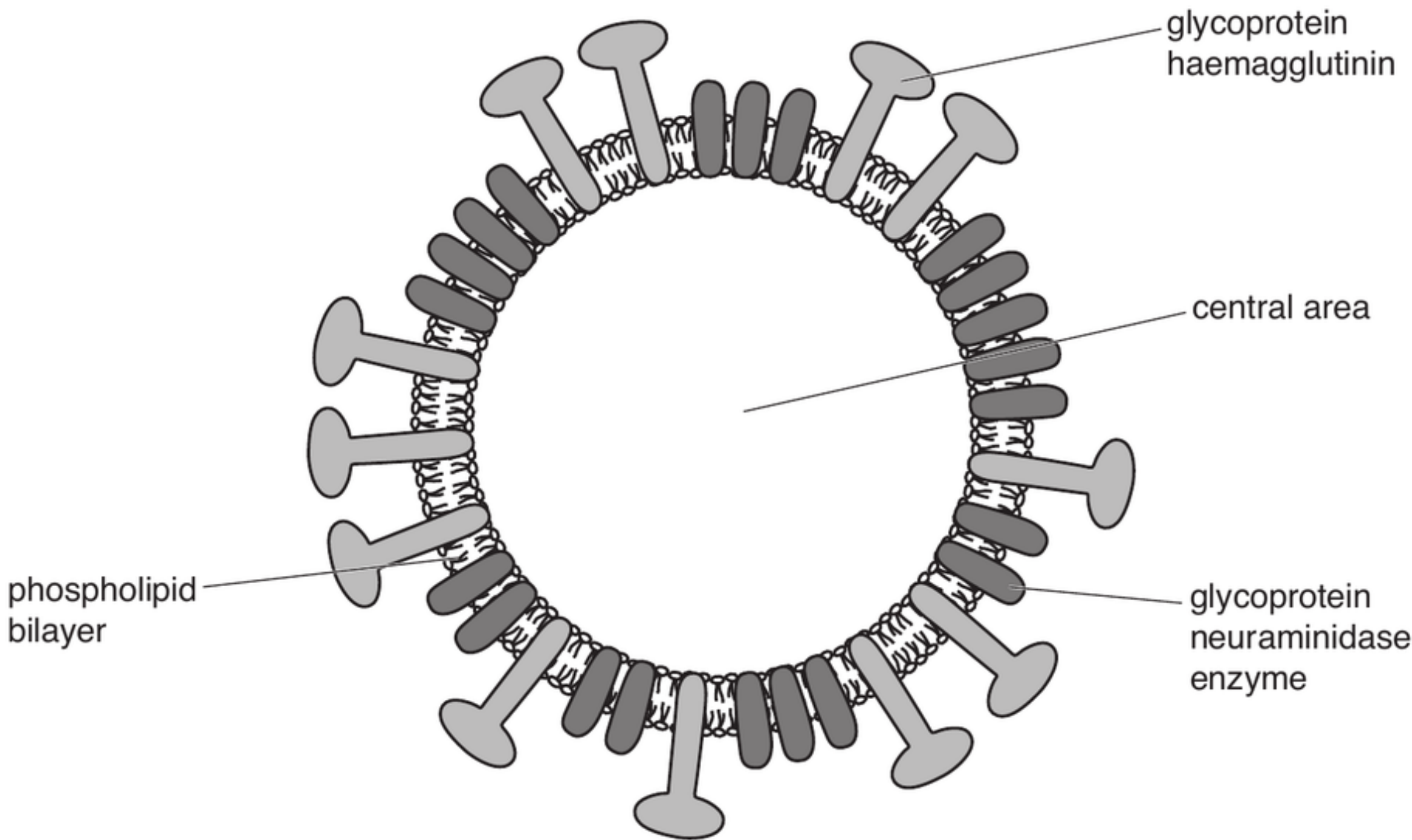


Fig. 4.1

- (i) State the differences between the structure of a virosome and a virus.
-
-
-
- [2]
- (ii) Explain how the structure of the virosome shown in Fig. 4.1 suggests that the central area of the virosome is aqueous.
-
-
-
-
- [2]
- (b) The glycoproteins haemagglutinin and neuraminidase are found in the influenza virus and in the virosomes used in a vaccine against the influenza virus.

Haemagglutinin binds to a receptor in the cell surface membrane of phagocytes.

Suggest why haemagglutinin is present in virosomes used in the vaccine for influenza.

.....

.....

.....

.....

.....

..... [2]

(c) Different strains of the influenza virus have formed as a result of mutations. Each strain of the virus contains the enzyme neuraminidase. Neuraminidase helps the virus to leave host cells after the virus has replicated. In each strain of the influenza virus, the primary structure of the active site of the neuraminidase enzyme remains unchanged.

Suggest why the primary structure of the active site of neuraminidase remains unchanged in each strain of the influenza virus.

.....

.....

.....

.....

..... [2]

Question No 22 - (9700_w22_21_5)
Subsection Topics: (a) : 7.2 - Transport mechanisms | (b) : 7.1 - Structure of transport tissues | (c) : 1.2 - Cells as the basic units of living organisms | (d) : 10.1 - Infectious diseases

- (a) When water molecules enter a plant through the roots, the molecules cross the cortex and enter the xylem tissue to be transported to other parts of the plant.

There are two pathways that water can take when crossing the root to the xylem tissue.

Complete Table 5.1 with information about the two pathways.

Table 5.1

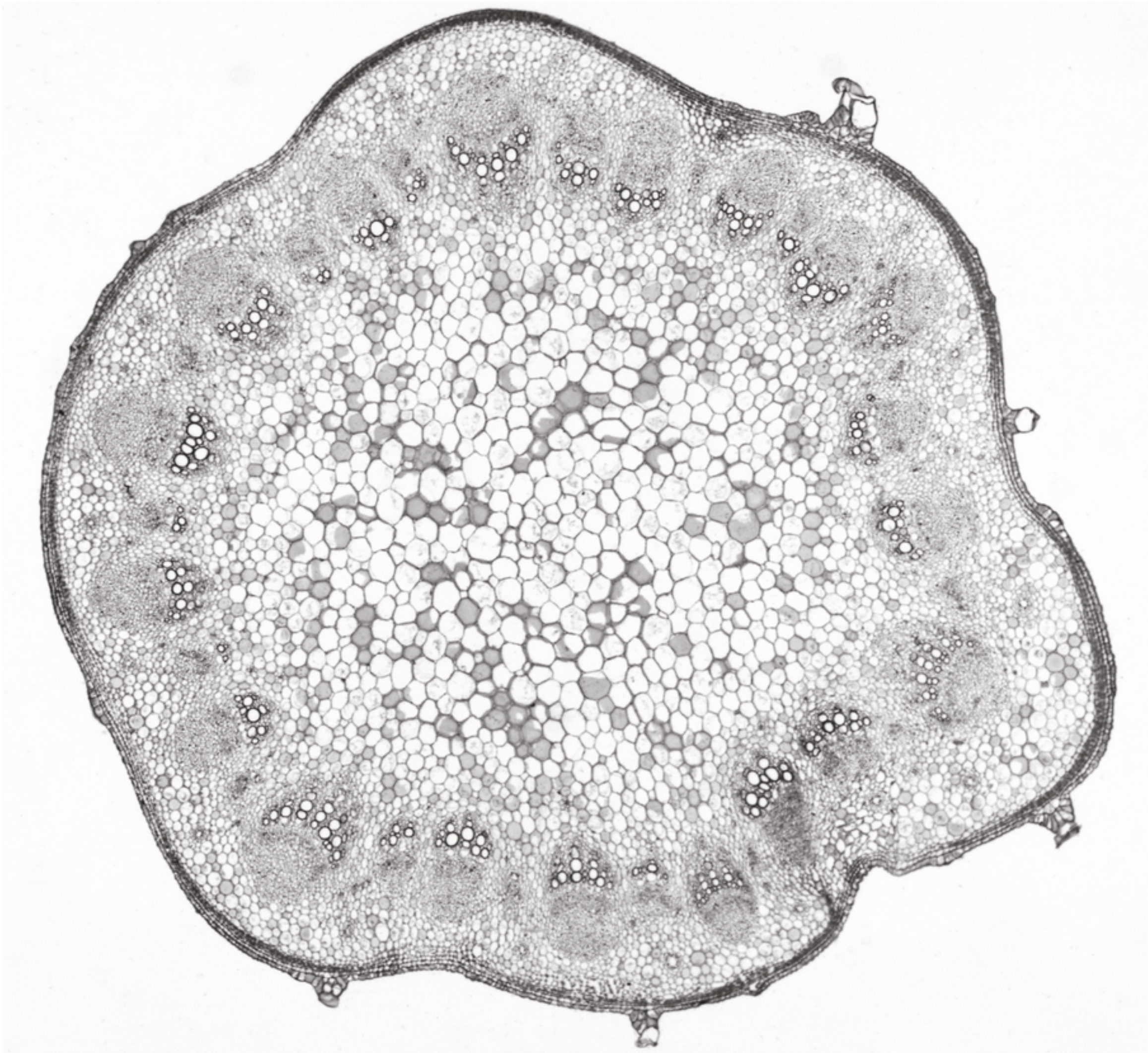
name of pathway	outline of pathway
	movement of water from cell to cell through plasmodesmata

[2]

- (b) Fig. 5.1 is a photomicrograph of a transverse section through the stem of a flowering plant.

On Fig. 5.1, draw a label line and the letter **T** to identify xylem tissue.

[1]



- (c) Scientists have studied the process of cell death that occurs during the development of the cells that become mature xylem vessel elements.

During this development, the tonoplast ruptures (bursts) and releases hydrolytic enzymes contained in the vacuole into the cytoplasm.

- (i) Name an organelle found in animal cells that has a similar function to the vacuole in the developing xylem vessel elements.

..... [1]

- (ii) The rupture of the tonoplast during development of xylem vessel elements is due to changes in permeability of the tonoplast.

Suggest how the permeability of the tonoplast changes **and** explain how this change could result in the rupture of the tonoplast.

.....
.....
.....
.....
.....
.....
.....
..... [3]

- (iii) During development of the xylem vessel elements the pH of the cytoplasm decreases. This change in pH activates enzymes in the cytoplasm that cause organelles to swell.

Suggest how a change in pH of the cytoplasm can activate enzymes.

.....

.....

.....

.....

.....

..... [2]

(d) Some insects are vectors of disease.

- (i) When an insect feeds on the xylem fluid it can act as a vector of plant diseases such as Pierce’s disease. This bacterial disease affects many fruit trees causing the leaves to turn brown and drop from the plant, resulting in much less fruit being produced.

Explain why Pierce’s disease can be described as an infectious disease.

.....

.....

.....

.....

..... [2]

- (ii) Malaria is another infectious disease that also involves an insect vector.

State the type of organism that causes malaria **and** name **one** organism that causes malaria in humans.

type of organism

name [2]

Question No 23 - (9700_w22_22_5)

Subsection Topics: (a) : 2.3 - Proteins | (b) : 2.3 - Proteins | (c) : 3.2 - Factors that affect enzyme action

Fibroblasts are one of the cell types of connective tissue. The cells synthesise and secrete collagen, which forms part of the supporting external cellular environment, known as the extracellular matrix.

(a) Fig. 5.1 shows the primary structure of a section of a polypeptide chain of collagen.

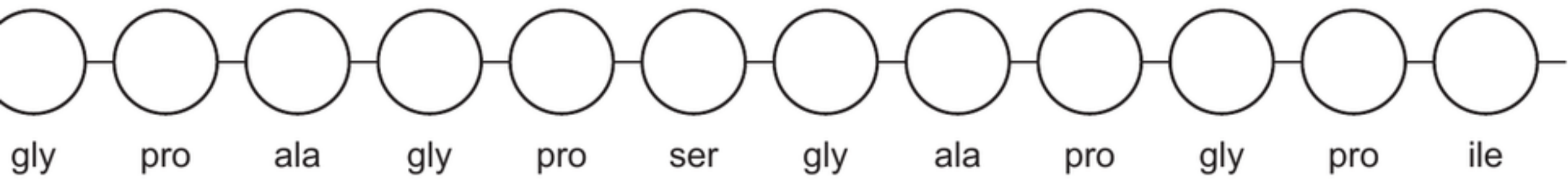


Fig. 5.1

Explain how the primary structure shown in Fig. 5.1 indicates that the structure of the polypeptide is suited to be a component of a collagen molecule.

.....

.....

.....

.....

.....

.....

..... [3]

(b) After final processing in the Golgi body, collagen is released to the outer surface of the cell by exocytosis.

Complete the passage to describe the process of exocytosis.

After final processing in the Golgi body,

.....

.....

.....

.....

.....

.....

.....

..... [3]

(c) Hydrolytic enzymes, known as collagenases, are secreted by cells in an inactive form.

Cells also secrete inhibitors of collagenases. The activity of the enzymes and inhibitors is regulated so that the development and maintenance of the extracellular matrix is controlled.

(i) State **and** explain what the outcome will be for the composition of the extracellular matrix if collagenase inhibitor activity is needed.

.....

.....

.....

.....

..... [2]

(ii) Synthetic inhibitors have been trialled as potential treatment for diseases caused by a lack of regulation of collagenase activity.

Research involves investigating the mechanism of action of an inhibitor.

State the effect that a **non-competitive** inhibitor will have on the maximum rate of reaction, V_{max} , and the Michaelis–Menten constant, K_m , of collagenase.

V_{max}

K_m [2]

Cathelicidin LL-37 is a cell signalling compound that stimulates many different cells in humans. One role of cathelicidin LL-37 is stimulating the production of endothelial cells in the formation of capillaries during wound healing.

- (a)

(i)

Explain how it is possible for many different cell types to respond to the same cell signalling compound.

[2]

(ii)

Describe the appearance of the endothelial cells of a capillary.

[2]

Cathelicidin LL-37 is a protein composed of 37 amino acids.

Table 5.1 shows:

- the sequence of the first 10 amino acids in the primary structure of cathelicidin LL-37
- DNA triplets in the non-transcribed strand in the gene that codes for the first 10 amino acids in the primary structure of cathelicidin LL-37.

Table 5.1										
amino acid position	1	2	3	4	5	6	7	8	9	10
amino acid	leu	leu	gly	asp	phe	phe	arg	lys	ser	lys
DNA triplet	CTG	CTG	GGT	GAT	TTC	TTC	CGG	AAA	TCT	AAA

Table 5.2 shows the triplets of bases in **DNA** and the amino acids for which they code.

Table 5.2										
second base										
first base			T		C		A		G	
		T	TTT	phe	TCT	ser	TAT	tyr	TGT	T
			TTC		TCC		TAC		TGC	C
			TTA	leu	TCA		TAA	stop	TGA	A
			TTG		TCG		TAG		TGG	G
		C	CTT	leu	CCT	pro	CAT	his	CGT	T
			CTC		CCC		CAC		CGC	C
			CTA		CCA		CAA	gln	CGA	A
			CTG		CCG		CAG		CGG	G
		A	ATT	ile	ACT	thr	AAT	asp	AGT	T
			ATC		ACC		AAC		AGC	C
			ATA	ile	ACA		AAA	lys	AGA	A
			ATG	met	ACG		AAG		AGG	G
		G	GTT	val	GCT	ala	GAT	asp	GGT	T
			GTC		GCC		GAC		GGC	C
			GTA		GCA		GAA	glu	GGA	A
			GTG		GCG		GAG		GGG	G
										third base

- (b)

Mutations of DNA base sequences in a gene can affect the primary structure of proteins.

Use the information in Table 5.1 and Table 5.2 to suggest the effect on the primary structure of cathelicidin LL-37 of:

(i)

the substitution of the base T with the base A in the middle of the triplet at position 5

[1]

(ii)

the deletion of base T in the triplet at position 2

.....
.....
..... [2]

(iii) the insertion of base G between bases G and T in the triplet at position 3.

.....
.....
..... [2]

(c) The genetic code is described as universal.

Explain why the genetic code is described as universal.

.....
.....
..... [1]

(d) Use Table 5.2 to explain why some mutations have no effect on the primary structure of a protein.

.....
.....
.....
.....
..... [2]

Question No 25 - (9700_m21_22_2)

Subsection Topics: (a) : 6.1 - Structure of nucleic acids and replication of DNA | (b) : 2.2 - Carbohydrates and lipids | (c) : 3.1 - Mode of action of enzymes | (d) : 3.2 - Factors that affect enzyme action

Starch molecules are the main storage molecules in many types of cereal grain, such as the grain of the barley plant.

(a) When the seed inside a barley grain germinates, genes coding for digestive enzymes are switched on. The enzymes that are synthesised catalyse the hydrolysis of storage molecules such as proteins and starch.

(i) Explain what is meant by a gene.

.....

.....

.....

.....

..... [2]

(ii) The hydrolysis of proteins in the barley seed produces amino acids that can be used in the synthesis of the proteins required for formation of the seedling (young plant).

Fig. 2.1 is an incomplete diagram of the molecular structure of the smallest amino acid, glycine. Each molecule of glycine has two carbon atoms.

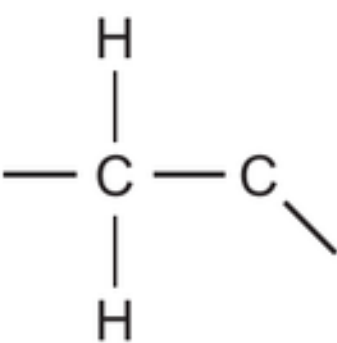


Fig. 2.1

Complete Fig. 2.1 to show the molecular structure of glycine. [2]

(iii) Starch is a mixture of two different molecules.

Name these **two** molecules.

.....

..... [1]

Two of the enzymes synthesised by the barley seed are α -amylase and maltase. These are involved in the hydrolysis of the stored starch during seedling formation.

In the food industry, the starch extracted from barley seeds (barley starch) is used in the production of sugar syrups. Fig. 2.2 summarises the reactions catalysed by α -amylase in the production of maltose syrup and by maltase in the production of glucose syrup.

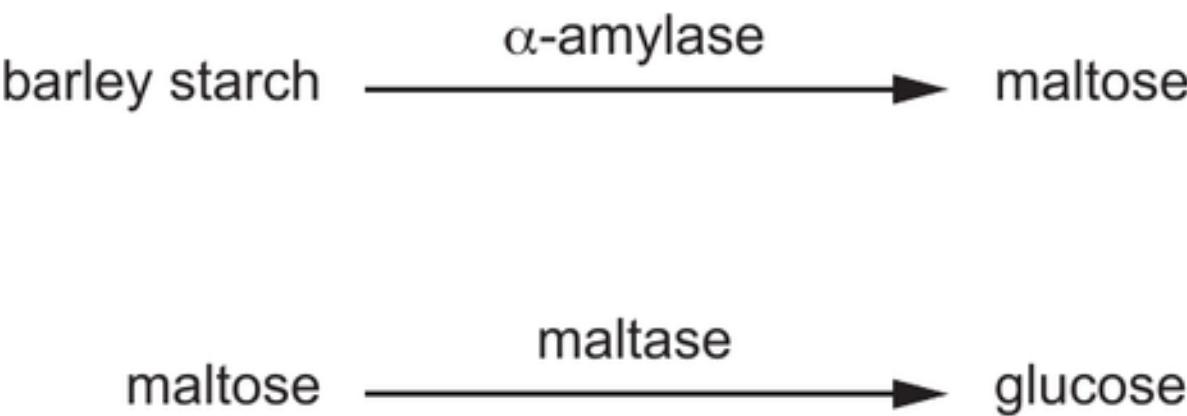


Fig. 2.2

(b) Some of the substances shown in Fig. 2.2 are listed in Table 2.1.

Complete Table 2.1 to identify which of the terms polysaccharide, monosaccharide and macromolecule apply to each of the substances listed.

Use a tick (✓) if the term applies and a cross (x) if the term does not apply.

Put a tick (✓) or a cross (x) in every box.

Table 2.1

substance	polysaccharide	monosaccharide	macromolecule
glucose			
maltase			
maltose			
starch			

[3]

When producing sugar syrups, there are advantages in using enzymes extracted from microorganisms.

For example, some enzymes extracted from microorganisms are heat stable. Heat-stable enzymes are used to increase productivity because the reactions can be carried out at higher temperatures.

(c) Suggest **one other** advantage of using enzymes obtained from microorganisms, rather than enzymes extracted from barley seeds, in the production of sugar syrups.

.....

..... [1]

(d) Fig. 2.3 is a graph showing how the activity of α -amylase extracted from barley seeds changes as the temperature increases from 10 °C to 66 °C.

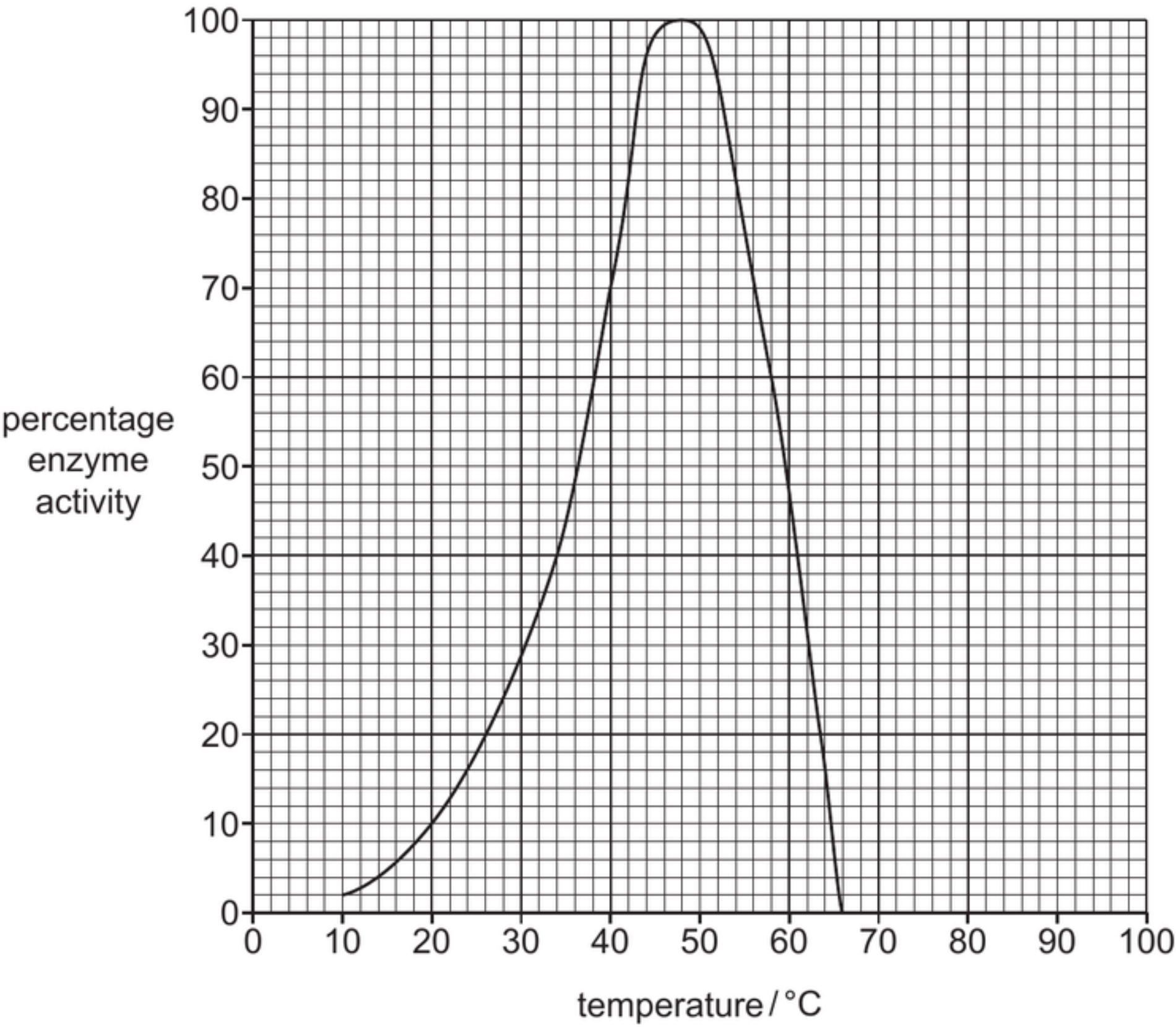


Fig. 2.3

(i) Explain the effect of temperature on the activity of α -amylase extracted from barley seeds, as shown in Fig. 2.3.

.....

.....

.....

.....

.....

.....

..... [3]

(ii) Sketch on Fig. 2.3 the curve that would be obtained using α -amylase enzyme that is heat stable. [2]

Question No 26 - (9700_s21_21_4)

Subsection Topics: (a) : 3.1 - Mode of action of enzymes | (b) : 3.2 - Factors that affect enzyme action | (c)
: 8.2 - Transport of oxygen and carbon dioxide

(a) The induced-fit hypothesis and the lock-and-key hypothesis are used to describe the mode of action of enzymes.

Explain the induced-fit hypothesis.

.....

.....

.....

.....

.....

..... [3]

(b) Radish plants contain the enzyme peroxidase that catalyses the breakdown of hydrogen peroxide.

Students investigated the effect of increasing the concentration of hydrogen peroxide on the activity of peroxidase extracted from radish.

The results of their investigation are shown in Fig. 4.1.

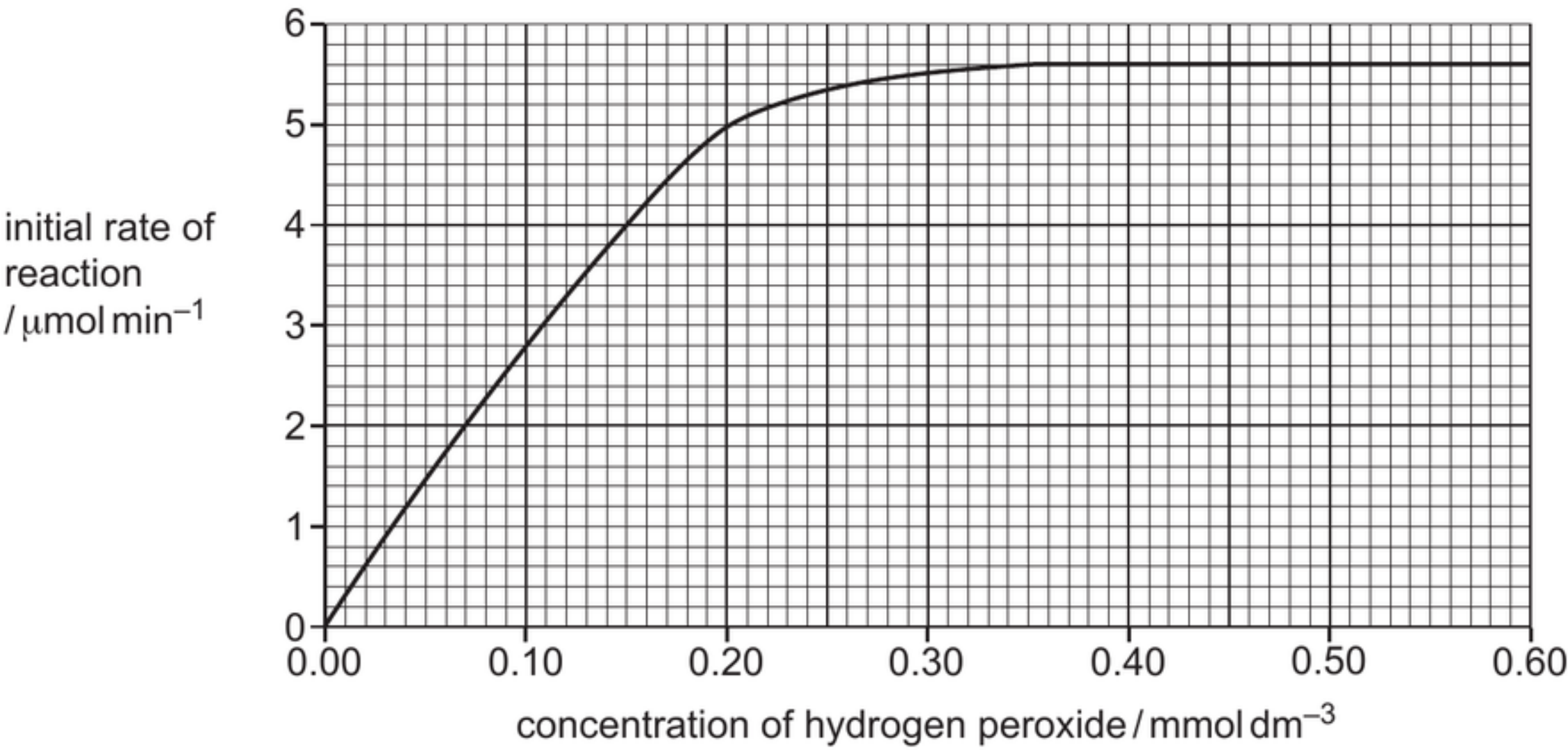


Fig. 4.1

(i) Explain the effect of increasing the concentration of hydrogen peroxide on the initial rate of reaction as shown in Fig. 4.1.

.....

.....

.....
.....
.....
..... [3]

(ii) The students determined the K_m for radish peroxidase as $0.10 \text{ mmol dm}^{-3}$.

With reference to Fig. 4.1, describe how they determined the K_m .

.....
.....
.....
..... [2]

(c) A further investigation found that the K_m for carbonic anhydrase is 12 mmol dm^{-3} .

Describe the role of carbonic anhydrase in the transport of carbon dioxide.

.....
.....
.....
.....
.....
.....
..... [3]

[Total: 11]

Question No 27 - (9700_s21_21_6)

Subsection Topics: (a) : 1.2 - Cells as the basic units of living organisms | (b) : 1.2 - Cells as the basic units of living organisms | (c) : 11.1 - The immune system | (d) : 3.1 - Mode of action of enzymes | (e) : 4.2 - Movement into and out of cells

Lysosomes are cell structures that contain enzymes known as acid hydrolases.

Fig. 6.1 shows some processes that occur in animal cells.

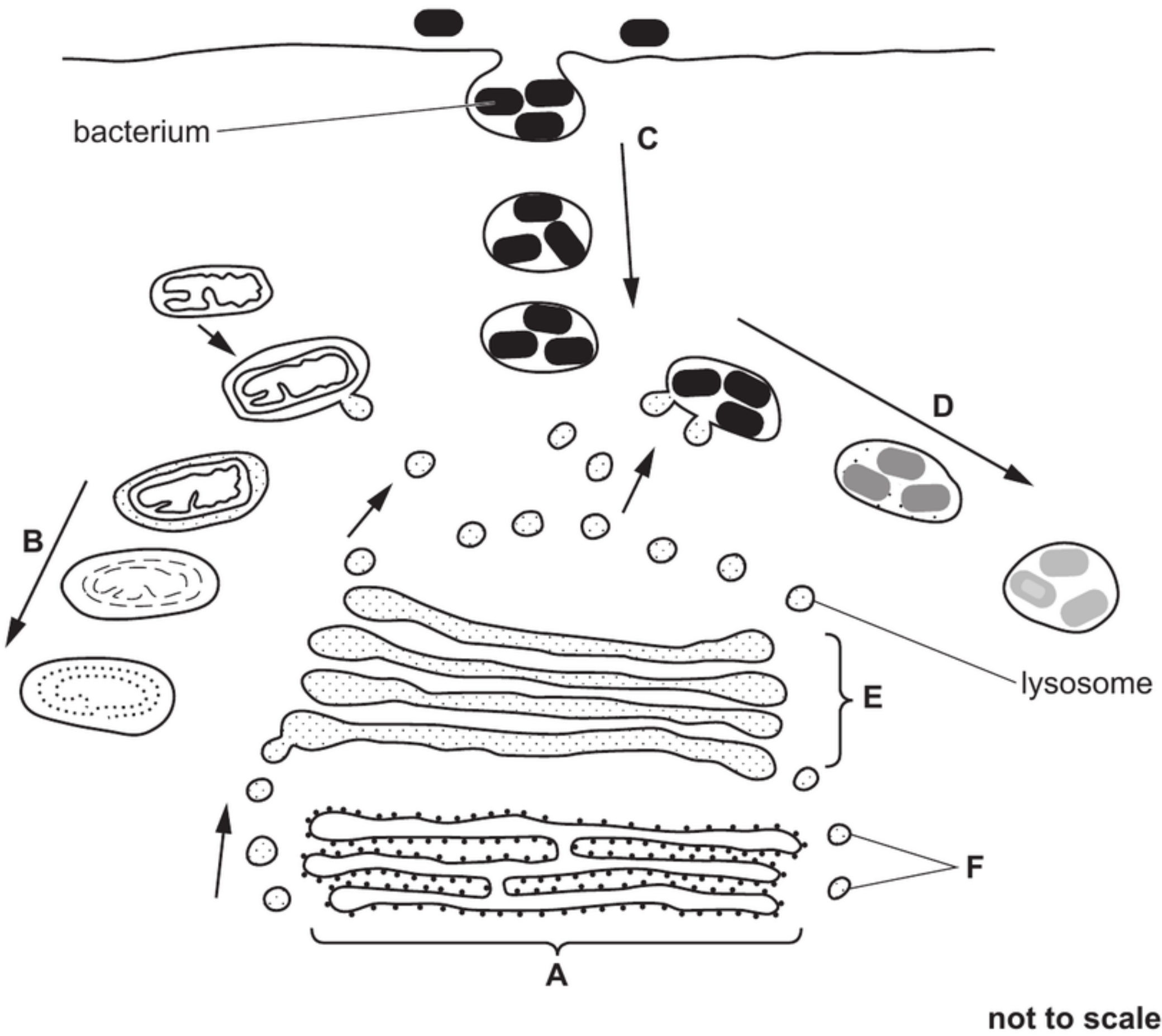


Fig. 6.1

- (a) Name the cell structures labelled **A** and **E**.
- A**
- E** [2]
- (b) State the function of the structures labelled **F**.
-
- [1]
- (c) Name the process by which bacteria are taken into the cell at **C**.
- [1]
- (d) With reference to the processes occurring at **B** and at **D** in Fig. 6.1, outline the role of acid hydrolases in lysosomes.

.....

.....

.....

.....

.....

.....

..... [3]

(e) Carrier proteins in the membranes of lysosomes maintain a lower pH than the surrounding cytoplasm by moving hydrogen ions.

Suggest how the carrier proteins maintain the lower pH within the lysosomes.

.....

.....

.....

.....

..... [2]

Question No 28 - (9700_s21_22_5)

Subsection Topics: (a) : 1.2 - Cells as the basic units of living organisms | (b) : 1.2 - Cells as the basic units of living organisms | (c) : 3.2 - Factors that affect enzyme action | (d) : 3.2 - Factors that affect enzyme action

Fig. 5.1 is a transmission electron micrograph showing parts of two plant cells. The function of the middle lamella is cell-to-cell adhesion. The middle lamella is composed of a polysaccharide known as pectin.

Pectin interacts with the polysaccharides cellulose and hemicellulose in the cell walls of the plant cells so that the cell walls are held close together, as shown in Fig. 5.1.

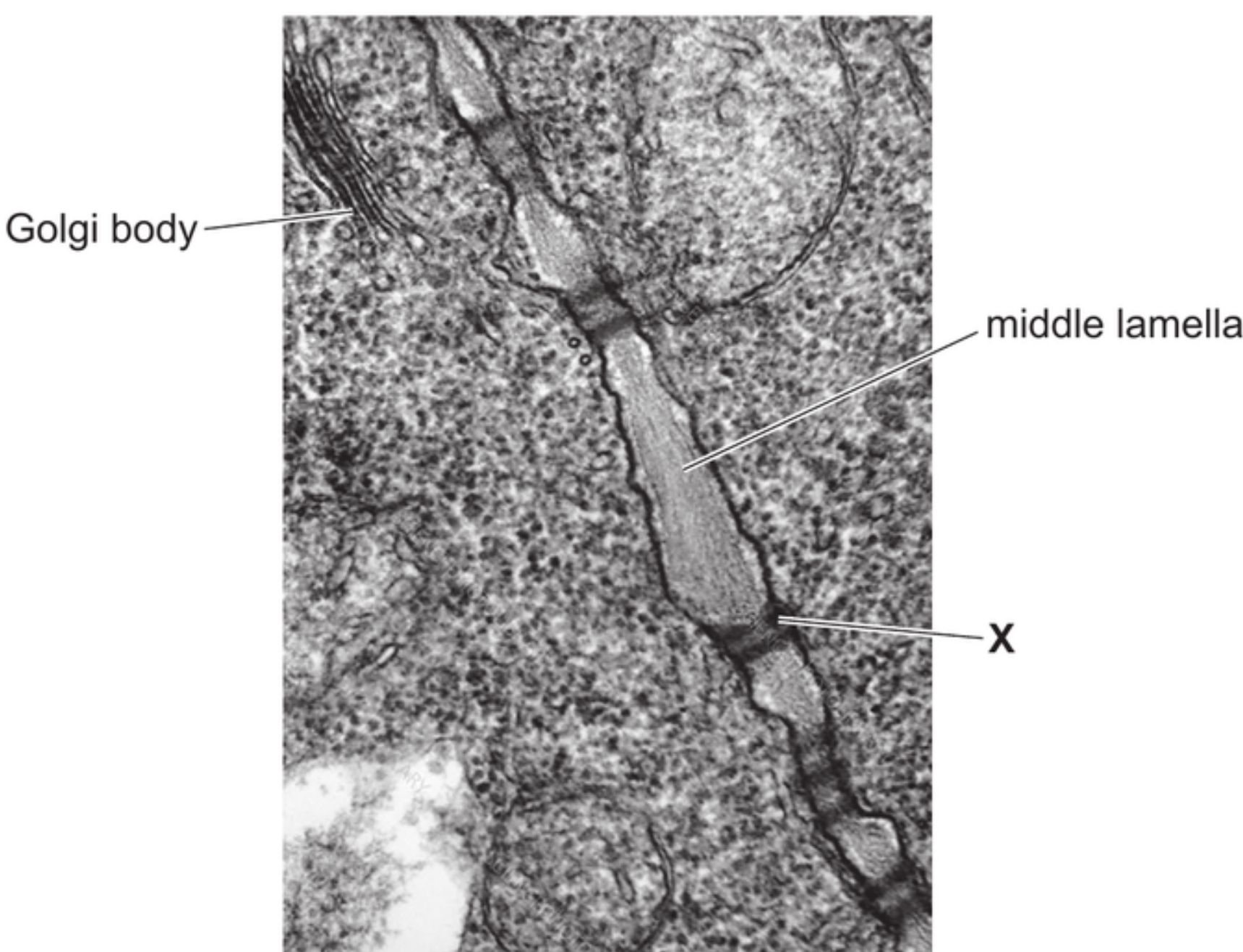


Fig. 5.1

(a) Cell structure **X** in Fig. 5.1 is a cytoplasmic channel with strands of cytoplasm passing through the cell walls of the two cells.

Name cell structure **X** and state **one** function of this cell structure.

name

function

..... [2]

(b) Researchers have discovered that pectin is synthesised within the Golgi body. Golgi vesicles containing pectin are moved to the cell surface membrane for release.

(i) Suggest why researchers would **not** have investigated ribosomes as being the possible location for the synthesis of pectin.

.....

..... [1]

(ii) Name the mechanism that is used to transport pectin out of the cell.

..... [1]

Juices that are extracted commercially from fruits can be made less cloudy by the breakdown of the cell wall using the enzymes cellulase, pectinase and xylanase:

- cellulase hydrolyses cellulose
- pectinase hydrolyses pectin
- xylanase hydrolyses hemicellulose.

(c) Fig. 5.2 is a graph showing the effect of cellulose concentration on the activity of cellulase, which is used in making fruit juice less cloudy.

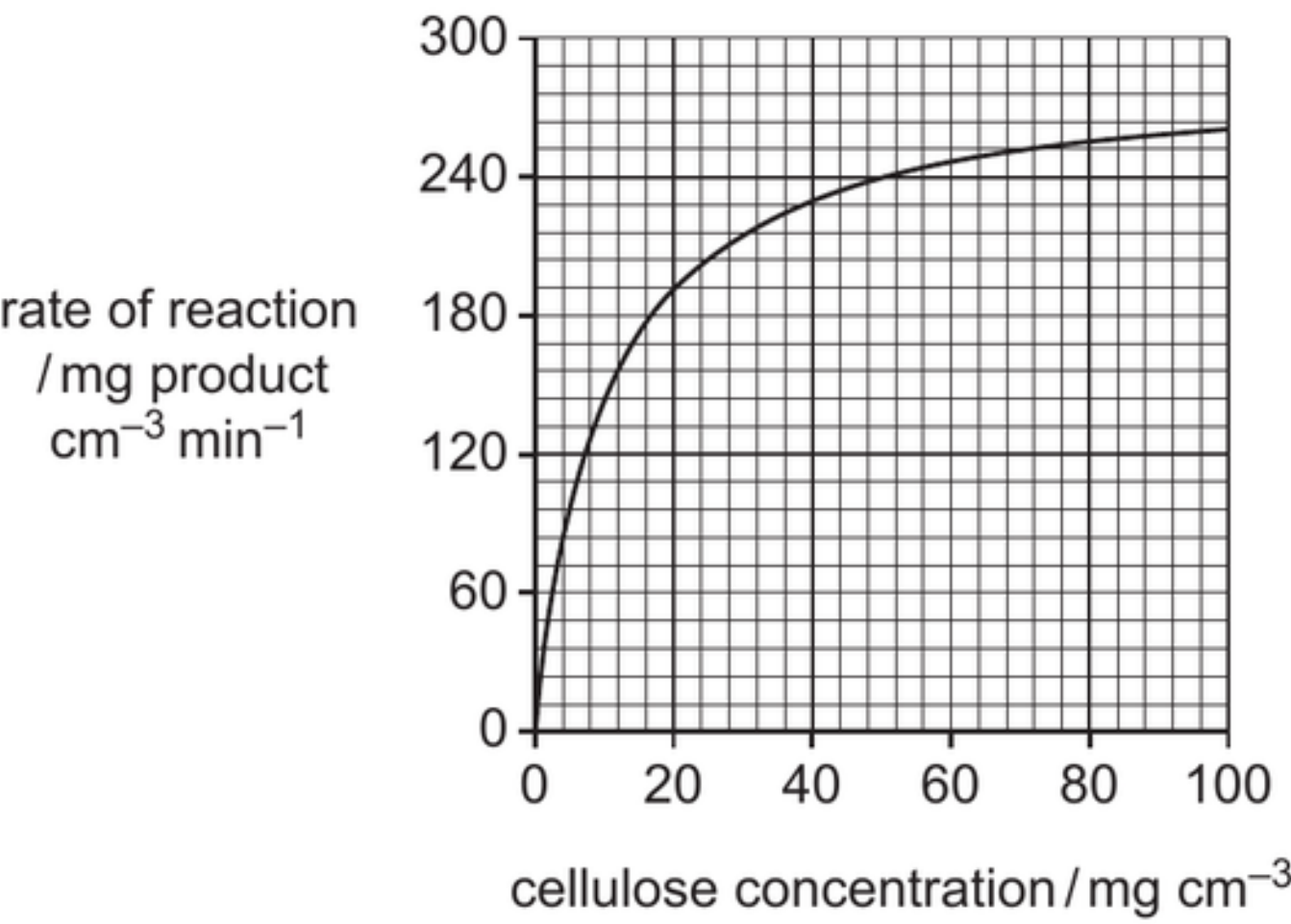


Fig. 5.2

Describe **and** explain the curve shown in Fig. 5.2.

.....

.....

.....

.....

.....

.....

.....

..... [3]

Answer for Question 1 (9700_m25_22_5)

Question	Answer	Marks												
5(a)	histones ; chloroplasts ; bacteria / cyanobacteria / Archaea ; accept named prokaryote cytoplasm ;	4												
5(b)(i)	non-transcribed strand ;	1												
5(b)(ii)	primary transcript ;	1												
5(b)(iii)	<table><tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td></tr><tr><td>A</td><td>U</td><td>G</td><td>C</td><td>A</td><td>U</td></tr></table> ;	1	2	3	4	5	6	A	U	G	C	A	U	1
1	2	3	4	5	6									
A	U	G	C	A	U									

Question	Answer	Marks
5(c)	any three from 1 ref. to non-competitive inhibition ; 2 binding of alpha-amanitin changes shape of active site ; 3 active site, no longer / less, complementary to, substrate / DNA or 4 fewer enzyme–substrate complexes formed ; 4 prevents RNA polymerase from, binding to DNA / unwinding DNA / rewinding DNA ; 5 blocks movement of the polypeptides of the enzyme / prevents the enzyme changing shape / hinders induced fit ; 6 RNA polymerase movement along DNA, prevented / slowed down ; accept prevents addition of nucleotides to the chain	3

Answer for Question 2 (9700_m24_22_1)

Question	Answer	Marks
1(a)(i)	glycerol ;	1
1(a)(ii)	any one from: hydroxyl / polar, group, interacts with, phosphate heads ; A idea that both are, polar / hydrophilic A hydroxyl group, faces aqueous environment / AW, as it is, polar / hydrophilic non-polar part, in region of / AW, fatty acid tails / AW, as both are, non-polar / hydrophobic ; A non-polar part is hydrophobic so, in centre of membrane / away from aqueous environment	1
1(a)(iii)	any one from: maintains / regulates, fluidity of membrane ; A detail e.g. reduces fluidity at high temperature / increases fluidity at low temperature / AW maintains / regulates, (mechanical) stability of membrane ; AW prevents entry of, hydrophilic substances / polar substances / ions ; without cholesterol membranes would easily rupture flat ring (<i>structure</i>) interferes with the movement of fatty acid tails reduces lateral movement of phospholipids	1
1(b)(i)	sodium ions are (positively charged), so repelled / AW, by the, hydrophobic tails / non-polar core / non-polar tails / AW ;	1

Answer for Question 2 (9700_m24_22_1)

Question	Answer	Marks								
1(b)(ii)	<i>similarity:</i> any one from 1 both occur through / involve, a, membrane / transport, protein ; A carrier protein <i>if context is correct</i> 2 (both can be) specific to the, molecule / ion (passing through) ; A correct ref. to binding site(s) on protein 3 (both involve) conformational change of (carrier) protein) ; R if incorrect context of channel protein AVP ; e.g. can transport substances, into and out of cell / in both directions ; <i>differences:</i> <table><tr><td><i>facilitated diffusion</i></td><td><i>active transport</i></td></tr><tr><td>substances transported down the concentration gradient</td><td>substances transported against a concentration gradient</td></tr><tr><td>passive A does not require, ATP / (metabolic) energy</td><td>requires, ATP / (metabolic) energy</td></tr><tr><td>involves channel and carrier proteins</td><td>does not involve channel proteins / only involves carrier proteins</td></tr></table> <i>If not given as a similarity allow as differences</i> <i>idea that active transport always involves conformational change (facilitated diffusion only carrier protein)</i> <i>idea that active transport always involves specific binding site(s) (facilitated diffusion only with carrier proteins)</i>	<i>facilitated diffusion</i>	<i>active transport</i>	substances transported down the concentration gradient	substances transported against a concentration gradient	passive A does not require, ATP / (metabolic) energy	requires, ATP / (metabolic) energy	involves channel and carrier proteins	does not involve channel proteins / only involves carrier proteins	3
<i>facilitated diffusion</i>	<i>active transport</i>									
substances transported down the concentration gradient	substances transported against a concentration gradient									
passive A does not require, ATP / (metabolic) energy	requires, ATP / (metabolic) energy									
involves channel and carrier proteins	does not involve channel proteins / only involves carrier proteins									
1(c)(i)	any one from: SER (membrane-bound so) can provide, phospholipid / arachidonic acid / substrate ; (prostaglandins are lipids and) SER is involved in lipid transport ; prostaglandins can be transported (from SER) or stored (in SER) ; idea of compartmentalisation / separated from other reactions in the cytoplasm / provides optimum conditions for pathway / higher concentration of enzymes (of pathway) ;	1								

Answer for Question 2 (9700_m24_22_1)

Question	Answer	Marks
1(c)(ii)	any three from: ref. to effect on, ionic bonding / hydrogen bonding / hydrophobic interactions, (with other R-groups) ; changes the, shape / conformation, of the active site ; active site no longer complementary to, arachidonic acid / substrate ; ref. to effect of activation energy not being reduced ; e.g. ref to changed charges (so no electron transfer) no longer provides hydrophobic regions for reaction to occur enzyme–substrate complex, not formed / formed at reduced rate ;	3
1(c)(iii)	any two from: A ligands for prostaglandins <i>if in correct context</i> 1 prostaglandins are, secreted / released, by cells or prostaglandins are, transported / AW, to target cells ; 2 prostaglandins bind to receptors (on target cell surface membranes) ; R antigens 3 example of events triggered leading to a response ; e.g. activation of secondary messenger enzyme, cascade / activation phosphorylation events signal transduction	2

Answer for Question 3 (9700_s24_21_3)

3(a)	(insect) vector / <i>Anopheles</i> / (a) mosquito ; <i>Plasmodium, falciparum</i> / <i>ovale</i> / <i>malariae</i> / <i>vivax</i> ; A <i>knowlesi</i> <i>Vibrio cholerae</i> and cholera ; A other pathogens and associated diseases that are transmitted in the same way <i>Mycobacterium, tuberculosis</i> / <i>bovis</i> ; airborne droplets / droplet infection / aerosol (infection) ; I air droplets I water droplets from, coughing / sneezing A alternative transmission only if <i>Mycobacterium bovis</i> stated e.g. (eating) contaminated meat (from infected cattle) (drinking) contaminated milk (drinking) unpasteurised milk from contaminated, cows / cattle	5
------	---	---

Question	Answer	Marks
3(b)	any two from: tenofovir competes with, (activated / phosphorylated) adenine nucleotide / deoxyribose adenosine triphosphate / dATP, for active site / to prevent nucleotides being added to elongating chain ; A (tenofovir acts as a) competitive inhibitor (of reverse transcriptase) tenofovir forms a phosphodiester bond to elongating DNA strand, but stops further reactions / AW ; tenofovir has, no 3' -OH so next nucleotide cannot form a phosphodiester bond / no (deoxy)ribose so cannot form phosphodiester bond ; A pentose R sugar unqualified	2
3(c)(i)	20 (%) ; R answers with decimal places	1

Answer for Question 3 (9700_s24_21_3)

Question	Answer	Marks
3(c)(ii)	<i>there must be at least one statement or at least one explanation to gain max 4, otherwise mark to max 3</i> <i>any four from:</i> 1 supply, condoms / femidoms / dental dams / item(s) for protection during sex ; 2 barrier to transmission during sexual intercourse ; 3 <i>ref. to</i>, needle exchange schemes / other suitable support for intravenous drug (ab)users ; I clean needles 4 decreases risk of sharing contaminated equipment / AW ; 5 use, new needles / new syringes / sterilised equipment / AW, for medical procedures ; I clean needles 6 decreases risk of transmission from contaminated blood ; 7 provide testing for HIV, in high risk groups / to individuals at high risk ; 8 for early diagnosis so newly infected people so can start drug treatment immediately ; 8 test pregnant women for HIV / provide powdered milk to women who are HIV positive ; 9 prevent women who are HIV positive passing HIV in breast milk ; 10 prevent people who are HIV positive being blood donors / screen donated blood / heat-treat donated blood ; 11 prevent people receiving blood infected with HIV, during blood transfusions / operations ; 12 carry out contact tracing ; 13 locate people who, are undiagnosed / may be HIV positive / should be offered test ; 14 supply (named) drug(s) to people, living with HIV / who are HIV positive / pregnant women with HIV ; 15 prevents HIV, spreading throughout the body / infecting more T-lymphocytes ; A to reduce viral load 16 provide, education / information, about, HIV treatments / HIV transmission ; 17 to raise awareness of ways to reduce infection / AW ; A use of barrier methods during sex / safer sex 18 AVP ; e.g. law to make it illegal to knowingly transmit the virus	4

Answer for Question 4 (9700_s24_22_3)

Question	Answer	Marks
3(a)	any three from: active site with a specific shape as part of a lysozyme molecule drawn and active site labelled or included in an annotation ; complementary shaped peptidoglycan drawn <u>and</u>, peptidoglycan / substrate, labelled or included in an annotation; enzyme-substrate complex drawn <u>and</u> labelled ; lysozyme with same shaped active site and, two products / NAM and NAG drawn (formed from hydrolysed peptidoglycan) ; AVP ; e.g. water shown enzyme active site labelled 'lock' and substrate labelled 'key' <i>max 2 if no ref. to specific example e.g. label for lysozyme or peptidoglycan or murein or the products NAG and NAM</i> <i>max 1 no labels but otherwise clearly lock and key</i> or by gaining the enzyme-substrate complex mark if induced fit drawn	3

Answer for Question 4 (9700_s24_22_3)

Question	Answer	Marks
3(b)	<i>allow murein for peptidoglycan</i> <i>must attempt similarities and differences to gain max</i> <i>any three from:</i> <i>similarities, both</i> 1 cause cell, lysis / bursting ; I ref.to destroying / killing, bacteria (both) 2 detail ; e.g. weaken / destroy / AW, cell wall act on peptidoglycan cell wall cell wall cannot withstand turgor pressure / AW <i>differences</i> <i>(lysozyme is, a protein / an enzyme / a catalyst, but)</i> 3 penicillin is, an antibiotic / an enzyme inhibitor / a beta-lactam ; <i>(lysozyme hydrolyses, glycosidic bonds / peptidoglycan molecules, but)</i> 4 penicillin, inhibits transpeptidase(s) ; A peptidase(s) 5 penicillin, prevents formation of / AW, peptide / cross, bridges / linkages ; R penicillin breaks cross bridges A ref. to autolysins e.g. 'cannot repair holes made by autolysins' 6 penicillin only effective when cell is, growing / synthesising cell walls, but lysozyme effective, at all stages / AW; 7 AVP ; e.g. lysozyme (much) larger molecule <i>ref. to lysozyme denatured v penicillin less affected by heat</i> <i>idea of lysozyme more affected by factors affecting enzyme</i> A examples lysozyme globular v penicillin contains (beta-lactam / 4-member) ring	3

Answer for Question 5 (9700_s24_23_4)

Question	Answer	Marks
4(a)	<i>Max 3 for suberin, max 3 for lignin</i> <i>any four from:</i> 1 lignin / suberin, is, hydrophobic / (partially) impermeable to water / AW ; e.g. waterproof / barrier to water <i>suberin</i> 2 suberin found in, Casparian strip / endodermal cells / endodermis ; 3 water must move from apoplast (pathway) to, symplast (pathway) / cytoplasm (at endodermis) ; 4 allows control of solutes / AW, before entering, endodermal cells / xylem ; A helps to prevent, toxins / bacteria / AW, entering xylem <i>in context of mp3</i> <i>lignin</i> 5 lignin found in, cell walls of xylem vessel elements / walls of xylem vessels ; A xylem / vessel, elements 6 <i>idea of</i> lignin / lignified wall, prevents water leaving xylem / loss of water from xylem ; 7 lignified walls, prevents, (inward) collapse of / compression of / AW, xylem ; R bursting 8 provides strength / secondary thickening, for (structural) support (of xylem) ; 9 <i>AVP : e.g. ref. to lignin as part of endodermis</i>	4

Question	Answer	Marks
4(b)	<i>max 4 if no reference to laccase / monolignols</i> <i>allow substrate(s) for monolignols</i> <i>any five from:</i> 1 laccase uses induced fit ; 2 <i>idea that</i> active site shape not fully complementary to (shape of) monolignols ; 3 active site changes shape to, fit / bind to, monolignols ; AW 4 becomes fully <u>complementary</u> ; 5 forming enzyme-substrate complex ; 6 lowers, activation energy / energy of activation; 7 suggestion of how activation energy is lowered ; 8 laccase returns to original shape, after product leaves active site / for re-use / AW ; 9 AVP ; e.g. <i>suggestion that</i>, copper ions are, cofactors / necessary for enzyme action <i>suggestion that</i> monolignols are held in place by (temporary) H bonds	5
5(a)	<i>any two from:</i> cells secrete ligands or	2

Answer for Question 6 (9700_w24_21_5)

Question	Answer	Marks
5(a)(i)	<i>correct answer as a whole number</i> 34(%) ;	1
5(a)(ii)	<i>allow enzyme for trypsin</i> <i>allow substrate for casein</i> any five from: 1 at lower concentrations there are not enough, active sites / enzymes ; 2 idea of substrate molecules cannot enter active site until product released ; 3 as concentration increases, increased number of active sites ; 4 idea that as concentration increases there are more successful collisions between enzyme and, substrate / casein ; 5 (so) allows increase in (number of) enzyme-substrate complexes (formed per unit time) ; 6 increased rate of casein breakdown as enzyme concentration increases ; 7 <i>ref. to</i> casein reaction e.g. milk becomes transparent as solution contains amino acids ; 8 AVP ; e.g. depends on how many active sites available at any one time <i>ref. to</i> enzyme-substrate complex formation per unit time at high concentration substrate concentration is becoming the limiting factor when clear, total hydrolysis of casein has occurred	5

Answer for Question 6 (9700_w24_21_5)

Question	Answer	Marks
5(b)(i)	<i>any one from:</i> immobilising the enzyme may have altered the, tertiary structure of the enzyme / shape of the active site ; <i>suggestion that</i> material may not be inert and may have an inhibitory effect at lower temperatures ; immobilising may have covered, part of the active site / active site of some enzymes ; <i>idea that</i> trypsin free in solution has increased chance of collision with substrate ; immobilising changes the optimum temperature of the enzyme ;	1
5(b)(ii)	<i>any two from:</i> immobilisation, protects / stabilises / AW, the, enzyme / trypsin ; from (thermal) denaturation ; ora enzyme free in solution denatured maintains shape of active site ; immobilisation may result in lower, kinetic energy / vibration, of the enzyme molecules compared to free (so protects from denaturation) ; ora prevents the breaking of bonds holding the tertiary structure (of immobilised enzyme molecule) ; ora <i>ref. to,</i> hydrogen / ionic bonds ;	2

Answer for Question 7 (9700_w24_22_2)

Question	Answer	Marks
2(a)	I protective gear / education about transmission / contact tracing / early diagnosis / testing any two from: practising safe sex / example ; A protected sex / using protection during sex A barrier contraceptives I use contraceptives screening blood, donated for / before, transfusions AW or not taking blood from high risk individuals / AW ; idea of treating donated blood (to inactivate viruses) ; A example e.g. heat / chemical treatment solvent-detergent treatment in context of drug abusers avoid sharing, needles / syringes / drug injecting equipment AW or use, new / sterile, needles / syringes / drug injecting equipment ; A cookers / sterile containers to mix drugs A use needle-exchange schemes / AW A use safe injection sites / AW avoid breast feeding / use baby milk products instead of breast milk ; pre-exposure prophylaxis / PrEP or post-exposure prophylaxis / PEP ; AVP ; e.g. using sterile equipment for, tattooing / surgery / dental procedures / body piercing	2
2(b)	the number of times larger an image is than actual ; AW I or smaller A formula stated in words A symbolised I/A to support a weakly worded answer A (in context of describing an image) enlargement / making larger / making bigger / increase in size / AW	1

Answer for Question 7 (9700_w24_22_2)

Question	Answer	Marks															
2(c)(i)	any one from: because bacteria have cell walls (only) of, murein / peptidoglycan ; because chitin is not found in bacterial cell walls ; A chitin / β-D-glucans, <u>main / major / AW</u> component of fungal cell walls	1															
2(c)(ii)	<table border="1"> <thead> <tr> <th>structural feature of <i>P. jirovecii</i></th><th>function</th><th>present (✓) or absent (x) in bacterial cells</th></tr> </thead> <tbody> <tr> <td>ribosomes</td><td>protein synthesis</td><td>✓</td></tr> <tr> <td>smooth endoplasmic reticulum</td><td>lipid / cholesterol / steroid, synthesis / metabolism AVP ; detoxification I carbohydrate metabolism</td><td>x</td></tr> <tr> <td>Golgi body</td><td>modification of proteins and lipids</td><td>x</td></tr> <tr> <td>mitochondrion / mitochondria</td><td>aerobic respiration</td><td>x</td></tr> </tbody> </table> one mark each correct column ;;; assume a tick that has been crossed is a cross ✕	structural feature of <i>P. jirovecii</i>	function	present (✓) or absent (x) in bacterial cells	ribosomes	protein synthesis	✓	smooth endoplasmic reticulum	lipid / cholesterol / steroid, synthesis / metabolism AVP ; detoxification I carbohydrate metabolism	x	Golgi body	modification of proteins and lipids	x	mitochondrion / mitochondria	aerobic respiration	x	3
structural feature of <i>P. jirovecii</i>	function	present (✓) or absent (x) in bacterial cells															
ribosomes	protein synthesis	✓															
smooth endoplasmic reticulum	lipid / cholesterol / steroid, synthesis / metabolism AVP ; detoxification I carbohydrate metabolism	x															
Golgi body	modification of proteins and lipids	x															
mitochondrion / mitochondria	aerobic respiration	x															

Answer for Question 7 (9700_w24_22_2)

Question	Answer	Marks
2(d)(i)	<i>allow squamous cells or squamous epithelial cells or epithelial cells for alveolar cells</i> <i>any two from:</i> 1 <i>gpA / (P. jirovecii) glycoprotein, <u>binds</u> to a, receptor / protein / glycoprotein on (surface of) alveolar cell</i> or <i>gpA <u>binds</u> to ECM, protein / glycoprotein ; I receptor</i> <i>A idea that ECM proteins are on, surface of / interacting with, (cell surface membrane of) alveolar cells</i> or <i>receptor / protein / glycoprotein on (surface of) alveolar cell is a binding site (for gpA) A same idea for ECM</i> 2 <i>(gpA) <u>complementary shape</u> ;</i> <i>allow ecf mp1 for gpA complementary shape to receptor on ECM</i> or <i>idea of complementary shape to attach / bind / adhere, to, alveolar cell / ECM</i> 3 <i>suggestion of adhering by, attractive charges / named bond types, between, gpA and, proteins / glycoproteins, on surface of alveolar cell / of ECM ;</i> 4 <i>AVP ; e.g. gpA acts as a <u>ligand</u></i>	2

Answer for Question 7 (9700_w24_22_2)

Question	Answer	Marks
2(d)(ii)	any three from: 1 alveolar cells / ECM, hindered / surrounded by / AW, <i>P. jirovecii</i> cells ; A alveolar wall becomes, thicker / AW 2 <u>diffusion</u> (of oxygen), impaired / decreased / AW ; A distance for <u>diffusion</u> increased A reduced surface area for <u>diffusion</u> ; 3 between, alveolus / alveolar air / alveolar space, and, capillary / blood / red blood cell(s) ; <i>allow mp if oxygen is clearly going in the correct direction</i> 4 less / AW, oxyhaemoglobin formed ; AW e.g. A less oxygen, binds to / taken up by / associates with, haemoglobin A less oxygen forms bonds with, Fe²⁺ / iron ion / iron, (in haemoglobin) 5 <i>idea of</i> ability of elastic fibres to, stretch / recoil, impaired / AW ; A <i>idea of</i> less elastic / decreased elasticity (of alveoli) 6 alveolar air not, refreshed / AW, so decreased diffusion gradient ; 7 AVP ; e.g. presence of macrophages hinders diffusion of oxygen <i>suggestion that P. jirovecii</i> infection, damages / AW, alveolar capillaries / venules / branches of pulmonary vein <i>suggestion that</i> oxygen used up for <i>P. jirovecii</i>, metabolism / activity / AW less ability of collagen to provide support to alveoli / AW	3

Answer for Question 7 (9700_w24_22_2)

Question	Answer	Marks
2(e)	any five from: casprofungin / drug, binds to site on, enzyme / glucan synthase, other than active site ; A binds to allosteric site changes shape of active site ; A enzyme changes, shape / tertiary structure, so active site is changed substrates cannot bind to active site / active site no longer complementary to substrates / enzyme-substrate complexes do not form ; A fewer enzyme-substrate complexes form less / no, (1,3- β-D) glucans / products, synthesised / produced ; cell wall, weakened / synthesis hindered / AW ; A cell wall not formed (leads to osmotic) lysis of, <i>P. jirovecii</i> / cell / fungus ; A bursting / cytolysis reduces / prevents, population growth ; AW e.g. decrease number of <i>P. jirovecii</i> A decreases ability of <i>P. jirovecii</i> to colonise / AW AVP ; e.g. <i>in context of lysis ref.</i> water entry into cell, by osmosis / down water potential gradient / AW (reduced number) increases chance of immune system eliminating the fungus	5

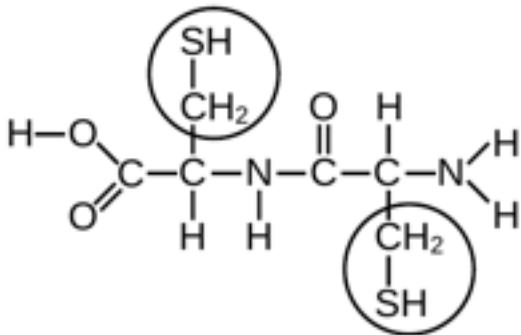
Answer for Question 8 (9700_w24_23_4)

Question	Answer	Marks
4(a)	any four from: I 'find optimum conditions for the enzyme mixture' A 'enzymes' for enzyme mixture 1 (find) suitable, raw material / crop wastes / substrate ; <i>using Table 4.1</i> 2 (find) crop waste that has high concentration of substrate for enzyme M ; ORA <i>assume answer is about solution or mixture unless told about individual enzymes (M, N and O)</i> 3 (find), optimum pH / optimum temperature ; A reference to, pH / temperature, for maximum activity I find optimum pH / temperature of each enzyme 4 (find) appropriate <u>concentrations</u> of the enzymes in the mixture ; I 'proportions' 5 <i>idea of</i> ratio of enzyme mixture to, raw material / substrate / crop waste ; 6 (find) the best pre-treatment of the, raw material / substrate / crop waste ; 7 (find) if any, inhibitors / cofactors, are <u>present in the solution</u> ; 8 (find) if any products are toxic ; 9 identify the sugars produced ; 10 (find) how long it takes to produce sugars / (find) rate of sugar production ; 11 <i>ref to</i> enzyme immobilisation ;	4
4(b)	any four from: 1 cellulose and, (named) protein / polypeptides, were present (in cell wall) ; e.g. expansins R if collagen 2 cellulose is broken down (fully) to β-glucose / β-glucose is the monomer of cellulose ; A 'made of' 3 protein / polypeptide / peptide, is broken down (fully) to amino acids ; A 'made of' 4 <i>idea that</i> partial hydrolysis has occurred to form, peptides / short chains of β-glucose ; 5 enzymes include cellulase and protease ; 6 breakage of glycosidic and peptide bonds ; A glucosidic 7 AVP ; e.g. beta 1-4 glycosidic linkage / exopeptidases producing amino acids / endopeptidases producing peptides	4

Answer for Question 9 (9700_m23_22_6)

Question	Answer	Marks
6(a)	any three from: covalent bonds between collagen molecules (between R groups / side-chains) ; covalent bonds are strong ; (molecules) staggered / overlapping molecules, so no weak areas (gives greater strength) ; (in skin) fibres line up in layers, not parallel / running in different directions ; provides tensile strength / strength in different directions ;	3
6(b)	any two from: at pH 8.0: ionic / hydrogen bonds, (between R groups) broken / altered ; active site shape altered ; (active site) no longer / less, complementary to substrate / collagen or fewer enzyme–substrate complexes formed ; AVP ; e.g. the amino acids in the active site affected by the changing pH ref. to partial denaturation	2

Answer for Question 10 (9700_m23_22_2)

Question	Answer	Marks
2(a)	either R group circled ; 	1
2(b)(i)	disulfide (bonds) ;	1
2(b)(ii)	<u>exocytosis</u> ; <i>plus any two from:</i> either: (idea of) vesicles will be large enough to contain many mucins / ref. to bulk transport ; vesicles forming from Golgi, body / apparatus ; vesicles moved by microtubules / cytoskeleton (to cell surface membrane) ; vesicles fuse with <u>cell surface membrane</u> ; active process / requires ATP ; AVP ; e.g. mucins are, polar / hydrophilic, so cannot cross, phospholipid bilayer / hydrophobic core of membrane or: mucin molecules are hydrophilic ; can exit via protein channels ; by facilitated diffusion ;	3
2(c)	<i>any two from:</i> (because mucus is too thick) cilia, have difficulty / AW, moving the mucus (upwards) ; pathogens, build up / not removed / AW ; more chance of, infection / disease ; AVP ;	2

Answer for Question 10 (9700_m23_22_2)

Question	Answer	Marks
2(d)(i)	deletion ;	1
2(d)(ii)	transcribed / template ; R transcription strand I anti-sense / coding, strand	1
2(d)(iii)	AUC AUU GGU GUU ;	1
2(d)(iv)	any three from: 1 idea of 3 bases coding for 1 amino acid ; 2 introns removed from, primary transcript RNA / AW ; A gene splicing / RNA splicing A mRNA does not contain introns R if not in correct context (primary transcript to mRNA) 3 introns / non-coding DNA, do not code for amino acids ; 4 (only) exons are joined together (to form mRNA) ; 5 DNA triplet / mRNA codon, for STOP does not code for an amino acid ; 6 methionine at start / first amino acid / amino acid coded for by START codon, removed ; 7 AVP ; e.g. ref. to (upstream) enhancer sequences ref. to (downstream) terminator sequences ref. to (non-coding) regulatory sequences / promoter	3

Answer for Question 11 (9700_s23_21_1)

Question	Answer	Marks																							
1(a)(i)	any one from: <u>no chloroplasts</u> (present) ; presence of (many) small vacuoles / no large vacuole / no central vacuole ; central nucleus or nucleus not located at the, edge / periphery ;	1																							
1(a)(ii)	one mark per row ;;; If 0 marks, allow 1 mark if name of cell structure column completed correctly <table border="1"> <thead> <tr> <th>function</th><th>name of cell structure</th><th>letter on Fig.1.1</th></tr> </thead> <tbody> <tr> <td rowspan="2">gas exchange</td><td>cell <u>surface</u> membrane I phospholipid bilayer</td><td>A</td></tr> <tr> <td>mitochondrial membrane(s)</td><td>E</td></tr> <tr> <td>production of subunits of ribosomes</td><td>nucleolus / nucleoli</td><td>C</td></tr> <tr> <td rowspan="4">active transport of ions</td><td>cell <u>surface</u> membrane ecf for cell membrane</td><td>A</td></tr> <tr> <td>or tonoplast / vacuolar membrane</td><td>F</td></tr> <tr> <td>or mitochondrial membrane(s)</td><td>E</td></tr> <tr> <td>or nuclear envelope A nuclear membrane(s)</td><td>B</td></tr> <tr> <td>aerobic respiration</td><td>mitochondrion / mitochondria</td><td>E</td></tr> </tbody> </table>	function	name of cell structure	letter on Fig.1.1	gas exchange	cell <u>surface</u> membrane I phospholipid bilayer	A	mitochondrial membrane(s)	E	production of subunits of ribosomes	nucleolus / nucleoli	C	active transport of ions	cell <u>surface</u> membrane ecf for cell membrane	A	or tonoplast / vacuolar membrane	F	or mitochondrial membrane(s)	E	or nuclear envelope A nuclear membrane(s)	B	aerobic respiration	mitochondrion / mitochondria	E	4
function	name of cell structure	letter on Fig.1.1																							
gas exchange	cell <u>surface</u> membrane I phospholipid bilayer	A																							
	mitochondrial membrane(s)	E																							
production of subunits of ribosomes	nucleolus / nucleoli	C																							
active transport of ions	cell <u>surface</u> membrane ecf for cell membrane	A																							
	or tonoplast / vacuolar membrane	F																							
	or mitochondrial membrane(s)	E																							
	or nuclear envelope A nuclear membrane(s)	B																							
aerobic respiration	mitochondrion / mitochondria	E																							
1(b)(i)	endocytosis / pinocytosis ; R phagocytosis	1																							

Answer for Question 11 (9700_s23_21_1)

Question	Answer	Marks
1(b)(ii)	<i>any three from:</i> 1 <u>hydrolysis</u> / use water to break bonds ; A <i>ref. to</i> hydrolytic enzymes 2 (action of) protease(s) / peptidases / proteolytic enzyme(s) ; 3 peptide bonds broken ; R if part of a list with other bonds not found in proteins, such as glycosidic, ester, phosphodiester 4 to form, peptides / amino acids ;	3
1(c)	1 formation of phagolysosomes / described ; A fusion with, phagosomes / phagocytic vesicle or vacuole 2 breakdown / digestion, of, pathogen / bacteria / microorganisms / AW ; A kill / destroy, pathogen / bacteria / microorganisms / AW <i>one from:</i> 3 (by) two named enzymes ; e.g. lysozyme, protease, lipase, carbohydrase, nuclease 4 any two named substrates that are hydrolysed ; e.g. polysaccharides, peptidoglycans, proteins, lipids, glycogen, nucleic acid(s) 5 to form, harmless / useful / soluble / AW, products ; I <i>ref. to</i> breakdown of organelles	2

Answer for Question 12 (9700_s23_22_2)

Question	Answer	Marks																											
2(a)	one mark each row to max 3 or = requires either root apical meristem or root cap cells statement <table> <tr> <th><i>root apical meristem cells</i></th><th></th><th><i>root cap cells</i></th></tr> <tr> <td>(some) cells in, mitosis / different stages of cell cycle ;</td><td>or</td><td>no cells in mitosis / all cells in interphase ; A no chromosomes visible / only chromatin visible</td></tr> <tr> <td>(some) cells in, prophase / metaphase / telophase ; A chromosomes visible (in some cells)</td><td></td><td>N/A</td></tr> <tr> <td>(generally) smaller (size) ; A less cytoplasm</td><td>or</td><td>(generally) larger (size) ; A more cytoplasm</td></tr> <tr> <td>larger nucleus in proportion to, size of cell / quantity of cytoplasm ;</td><td>or</td><td>smaller nucleus in proportion to, size of cell / quantity of cytoplasm ;</td></tr> <tr> <td>nucleoli / nucleolus, (more) visible / prominent / AW ;</td><td>or</td><td>nucleoli / nucleolus, not visible / not prominent / AW ;</td></tr> <tr> <td>(generally all) cuboidal / same shape ; A rectangular / regular (shape)</td><td>or</td><td>variety of shapes / shape described ; A irregular / circular</td></tr> <tr> <td><i>ref.</i> arrangement of cells ; e.g. rows / chains / tightly packed / compact / uniform / regular</td><td>or</td><td><i>ref.</i> arrangement of cells ; e.g. irregular / loosely packed / more intercellular spaces</td></tr> <tr> <td>AVP ; e.g. all / more, cells have nuclei cells not, sloughing off / detaching</td><td>or</td><td>AVP ; e.g. some have no nucleus some cells, sloughing off / detaching</td></tr> </table>	<i>root apical meristem cells</i>		<i>root cap cells</i>	(some) cells in, mitosis / different stages of cell cycle ;	or	no cells in mitosis / all cells in interphase ; A no chromosomes visible / only chromatin visible	(some) cells in, prophase / metaphase / telophase ; A chromosomes visible (in some cells)		N/A	(generally) smaller (size) ; A less cytoplasm	or	(generally) larger (size) ; A more cytoplasm	larger nucleus in proportion to, size of cell / quantity of cytoplasm ;	or	smaller nucleus in proportion to, size of cell / quantity of cytoplasm ;	nucleoli / nucleolus, (more) visible / prominent / AW ;	or	nucleoli / nucleolus, not visible / not prominent / AW ;	(generally all) cuboidal / same shape ; A rectangular / regular (shape)	or	variety of shapes / shape described ; A irregular / circular	<i>ref.</i> arrangement of cells ; e.g. rows / chains / tightly packed / compact / uniform / regular	or	<i>ref.</i> arrangement of cells ; e.g. irregular / loosely packed / more intercellular spaces	AVP ; e.g. all / more, cells have nuclei cells not, sloughing off / detaching	or	AVP ; e.g. some have no nucleus some cells, sloughing off / detaching	3
<i>root apical meristem cells</i>		<i>root cap cells</i>																											
(some) cells in, mitosis / different stages of cell cycle ;	or	no cells in mitosis / all cells in interphase ; A no chromosomes visible / only chromatin visible																											
(some) cells in, prophase / metaphase / telophase ; A chromosomes visible (in some cells)		N/A																											
(generally) smaller (size) ; A less cytoplasm	or	(generally) larger (size) ; A more cytoplasm																											
larger nucleus in proportion to, size of cell / quantity of cytoplasm ;	or	smaller nucleus in proportion to, size of cell / quantity of cytoplasm ;																											
nucleoli / nucleolus, (more) visible / prominent / AW ;	or	nucleoli / nucleolus, not visible / not prominent / AW ;																											
(generally all) cuboidal / same shape ; A rectangular / regular (shape)	or	variety of shapes / shape described ; A irregular / circular																											
<i>ref.</i> arrangement of cells ; e.g. rows / chains / tightly packed / compact / uniform / regular	or	<i>ref.</i> arrangement of cells ; e.g. irregular / loosely packed / more intercellular spaces																											
AVP ; e.g. all / more, cells have nuclei cells not, sloughing off / detaching	or	AVP ; e.g. some have no nucleus some cells, sloughing off / detaching																											

Answer for Question 12 (9700_s23_22_2)

Question	Answer	Marks
2(b)	any three from: max 1 mark (from mp1 / mp2) if response completely based on water movement within the plant mps 1-4: ref. to water <u>molecules</u>, needed once only / apply ecf water <u>molecules</u> form hydrogen bonds ; A H bonds / H bonding cohesion between water <u>molecules</u> (in spaces) ; A cohesive force between water molecules cohesion to water <u>molecules</u>, adhering / AW, to soil, particles / clumps ; adhesion of water <u>molecules</u> to, soil, surface / particles / clumps / mucilage / polysaccharides ; A adhesive force of water <u>molecules</u> AVP ; e.g. clumps provide, areas / (small) spaces / place, in which water collects <i>idea of</i> stable environment e.g. reduced movement of water, in / around clumps I keeps water around the, soil clumps / the root tip	3
2(c)	extracellular (enzymes) ;	1
2(d)(i)	more than two / three or more / many / large number of / polymer of, monosaccharides / sugar monomers / sugar units / simple sugars / carbohydrate subunits / AW ; A macromolecule <i>for large number of</i> R if includes incorrect example of a polysaccharide, e.g. sucrose <i>plus one from:</i> joined by / AW, glycosidic bonds ; <i>idea of</i> repeating, subunits / units / monomers / AW ;	2

Answer for Question 12 (9700_s23_22_2)

Question	Answer	Marks
2(d)(ii)	<i>all correct (NH₂ or COOH groups on left or right) ;</i> R-group / side chain, is variable or different amino acids have different, R-groups / side chains ; AW <i>this can be annotated on the diagram</i>	2
2(d)(iii)	<i>any three from:</i> I ref. to concentration of water / solute concentration A ψ for water potential mineral ions / nutrients, are solutes / dissolve in water ; (solutes) decrease / lower, water potential, within cell / in cytosol / in cytoplasm ; A water potential becomes, more negative / low increases / steep(er) / presence of / AW, water potential gradient ; A the difference in ψ between soil solution and cell increases A water moves from high to low water potential water follows osmotically / water enters by osmosis ; <i>in context of, presence / uptake, of mineral ions</i>	3

Answer for Question 13 (9700_s23_23_3)

Question	Answer	Marks
3(a)(i)	X neutrophil ; Y monocyte ; A lymphocyte I B– / T–	2
3(a)(ii)	(magnification) = $\frac{\text{image / line Z, length / width}}{\text{actual width}}$; A (M) = I / A A magnification triangle (x) 1500 ; A 1375 (for 11 mm) / 1438 (for 11.5 mm)	2

Question	Answer	Marks
3(b)(i)	<i>any four from:</i> 1 (carbonic anhydrase) catalyses the reaction between CO ₂ and H ₂ O ; AW 2 to form, carbonic acid / H ₂ CO ₃ ; 3 H ⁺ forms (together with HCO ₃ ⁻ from dissociation of H ₂ CO ₃) ; 4 H ⁺ binds to haemoglobin to form haemoglobinic acid ; 5 displacing / releasing, oxygen from haemoglobin ; 6 allosteric effect / change in tertiary structure / AW, in (oxy)haemoglobin (causes release of oxygen) ;	4
3(b)(ii)	curve below the original line ; curve, merging / will merge, with the original line after it begins to plateau ;	2

Answer for Question 14 (9700_w23_21_6)

Question	Answer	Marks
6(a)(i)	S phase / synthesis phase / interphase ;	1
6(a)(ii)	any two from: does not have an OH group (on C3) so condensation reaction cannot occur ; phosphodiester bond cannot form between deoxyribose and phosphate of adjacent nucleotide ; is a different shape because it has H instead OH (on C3) ; shape not complementary to the active site of DNA polymerase or no, enzyme substrate complexes / ESCs, can form ;	2
6(b)(i)	any two from: (both increase K_m, therefore both) reduce the affinity (of RNA polymerase for its substrate) ; (presence of) F52 reduces the affinity for the substrate more than F47 ; ora for F47 AVP ; e.g. manipulation of data to support described trend correct link stated between K_m values and affinity	2

Answer for Question 14 (9700_w23_21_6)

Question	Answer	Marks
6(b)(ii)	any three from: <i>decreased, maximum rate of reactions / rate of transcription because</i> $V_{\max}$ lower, qualified ; binding (of the aptamer) changes, the tertiary structure / shape of, active site (of RNA polymerase) ; A binding changes shape of enzyme so active site less complementary to substrate (so) substrate / (RNA) nucleotides, bind less easily to active site ; A fewer enzyme-substrate complexes form binding of aptamer prevents, substrate / (RNA) nucleotide, binding to active site ; binding prevents RNA polymerase from binding to template strand ; binding prevents RNA polymerase from forming bond between RNA nucleotides ; AVP ;	3

Answer for Question 15 (9700_w23_22_2)

Question	Answer	Marks
2(a)	secondary (structure) ;	1
2(b)	any one from: <i>idea that area to be, hydrolysed / AW, could be between same amino acids ;</i> A ref. to (always), hydrolyses / breaks down / acts on, peptide bonds suggestion that active site has (some) flexibility for, hydrolysing / binding to / AW, similar substrates ; (proteins / substrates) similar shape(s) so fit active site ; active site and, substrates / proteins, (still) have complementary shapes ; R 'complementary to the antigen or the shape' AVP ; e.g. (large enzyme / enzyme complex, with) more than one active site	1

Answer for Question 15 (9700_w23_22_2)

Question	Answer	Marks
2(c)	any three from: fibrous ; A not globular I structural insoluble / does not dissolve / does not dissolve easily ; (high proportion of) disulfide bonds / disulfide bridges / covalent bonds (because of cysteines) ; high proportion of / many / AW, hydrogen bonds (between polypeptides) ; high proportion of / many, hydrophobic interactions ; A many, amino acids with hydrophobic R-groups / hydrophobic R-Groups tight / close, packing, of, chains / polypeptides / molecules ; I triple helix AVP ; e.g. arranged so peptide bonds are not accessible parts of molecule needing to bind to active site not accessible many amino acids with small R-groups / small amino acids I details specific to collagen e.g. gly every third amino acid amino acids	3

Answer for Question 15 (9700_w23_22_2)

Question	Answer			Marks
2(d)	keratinase	temperature range at 60% relative activity / °C	pH range at 60% relative activity	4
	K12	41 – 63	6.8 / 6.9 – 8.4 ;	
	A22	36 / 36.5 – 57 ; A 57.1 / 57.2	6.0 – 9.0	
	P3	29 – 56	5.3 – 7.5	
	P3 ; A22 ;			

Answer for Question 15 (9700_w23_22_2)

Question	Answer	Marks
2(e)	<i>must have pH <u>and</u> °C <u>and</u> %, at least once</i> <i>max 2 if only Fig. 2.1 or only Fig. 2.2 used for the response.</i> <i>any three from:</i> <i>advantage from Fig. 2.1 (temperature)</i> 1 A22 <u>and</u> K12, active / remove stains, at a wide range of temperature or stated (active) temperature range of, A22 is 20.5 / 21 °C or K12 is 22 °C or use of Fig. 2.1 to give % activity and stated temperature of, good / above 60%, activity at, medium / hotter, temperature washes for, A22 / K12 ; or K12 active at low temperature (washes) ; A data e.g. 37–40% activity at 20 °C / 41–43% activity at 30 °C <i>disadvantage from Fig. 2.1 (temperature)</i> 2 low activity / poor stain removal, at 30 °C / 70 °C / 80 °C, for A22 or at 20 °C / 30 °C / 70 °C, for K12 ; A data extracted from Fig. 2.1 <i>advantage from Fig. 2.2 (pH) – activity in alkaline conditions</i> 3 A22, greatest activity / most effective / AW, pH 7.5 – 8.0 or (at least 60%) activity between pH 7.5 – 9.0 ; A range of pH 6.0 – 9.0 but R if stated pH 6.0–7.0 is alkaline or K12, active between pH 7.5 – 8.0 / 8.5 or optimum activity at pH 8.0 or data for (good) activity at stated pH values from Fig. 2.2 for either A22 or K12 ; <i>disadvantage from Fig. 2.2 (pH)</i> 4 use of Fig. 2.3 to show a decrease in activity at higher pH values ;	3

Answer for Question 15 (9700_w23_22_2)

Question	Answer	Marks
2(e)	5 any wash feature in context of mp 1–4 ; e.g. have (some) activity at low temperatures so, more economic /less energy used (to heat water) A ora active at high temperatures but, more costly / needs (more) energy can wash at high(er) temperature so, can sanitise clothes / can kill insect pests / can kill pathogens / shorter time to remove stains comparison of K12 and A22 for washes e.g. K12 more, thermostable / stable in (washes at) higher temperatures K12 has higher optimum temperature so more, costly / energy used K12 only useful at lower alkaline pH A22 has wide(r) working range of pH A22 more tolerant to / stable at, higher pH	

Answer for Question 16 (9700_w23_23_2)

Question	Answer	Marks
2(a)(i)	more, starch / amylose, is produced so iodine (solution), becomes dark(er) / changes from yellow-brown to blue-black ;	1
2(a)(ii)	<i>prediction</i> absorbance remains, constant / reaches plateau / at 1.80 ; A 1.79–1.81 A increases and flattens <i>explanation</i> all, substrate / G-1-P, used up / converted to amylose ; A colorimeter reached its limit for absorbance (at about 2.00) A substrate concentration is limiting or <i>prediction</i> absorbance increases less steeply / increase slows down ; <i>explanation</i> substrate concentration is (becoming) limiting / AW ; A substrate concentration is a limiting factor	2
2(a)(iii)	any one from: colorimeter gives, quantitative / numerical, results / readings ; <i>idea that</i> can use values from the colorimeter to plot graph(s) ; results are not subjective / no judgements made by eye / AW ; <i>idea that</i> can use calibration curve to determine concentrations (of starch) ; can take continuous readings / do not have to take samples ; I 'more accurate', 'actual results', 'reliable', 'exact', 'precise', etc.	1

Answer for Question 16 (9700_w23_23_2)

Question	Answer	Marks
2(b)	any four from: 1 substrate / glucose / G 1-P, binds to active site / forms enzyme-substrate complex / forms ESC ; 2 <u>end of amylose</u> / glucose (residue) at end of amylose (molecule), binds to active site / forms enzyme-substrate complex / forms ESC ; 3 active site changes shape when substrate(s) bind ; <i>ref. to induced fit</i> 4 enzyme decreases the activation energy ; 5 (α-1,4-)<u>glycosidic bond</u> forms ; A glucosidic 6 condensation (reaction) / water formed / AW ; 7 AVP ; e.g. any detail of binding to active site – formation of hydrogen bonds e.g. phosphate ion leaves active site e.g. substrate molecules, put under strain / reach transition state / AW <i>accept a diagram to show bond formation</i>	4

Answer for Question 17 (9700_m22_22_3)

Question	Answer	Marks
3(a)	<i>any four from:</i> 1 disaccharide to monosaccharides ; 2 R is water / water required ; 3 hydrolysis reaction ; 4 glycosidic bond broken ; 5 S is α-glucose ; 6 detail of enzyme action ; e.g. induced fit or lock and key hypothesis described 7 AVP ; e.g. (β-)1,4(-glycosidic) bond broken	4
3(b)(i)	<i>intracellular advantage:</i> <i>idea of control / maintaining balance / efficient metabolism ;</i> e.g. if, (enough) glucose / galactose / monosaccharides, present then no need for, uptake / breakdown, of lactose avoids osmotic problems as no build-up of monosaccharides high quantities of product means no requirement for use in respiration by cell <i>disadvantage:</i> loss of product / reduced productivity / product required continuously / slows rate of reaction / ref. to enzyme needing to remain active ;	2
3(b)(ii)	<i>any one from:</i> products and enzyme kept separated / AW ; product removed immediately ;	1
3(b)(iii)	<i>any one from:</i> inert / unreactive / cannot be digested by lactase / AW ; non-toxic ; insoluble ; long shelf-life ; AVP ; e.g. can create small mesh size suggestion of enzyme attachment to fibres	1

Answer for Question 17 (9700_m22_22_3)

Question	Answer	Marks
3(c)	any three from: 1 ref. to controlled variables ; e.g. constant, pH / temperature 2 take samples at timed intervals ; A regular intervals 3 determine, substrate concentration / product concentration ; 4 plot graph of, dependent variable (y-axis) against time (x-axis) ; 5 ref. to rate of disappearance of substrate or ref. to rate of appearance of product ; 6 determine initial rate ;	3

Answer for Question 18 (9700_s22_21_3)

Question	Answer	Marks
3(a)	1 active site, shape / tertiary <u>structure</u> ; 2 <u>complementary</u> to, substrate(s) / (intracellular) protein / ATP ;	2
3(b)	any three from: 1 at low(er) concentrations / AW, of, substrate / ATP, lower rate of activity with GNF-5 ; 2 as substrate concentration increases, effect of GNF-5 decreases ; 3 maximum rate of reaction / $V_{\max}$ / described, is the same ; 4 Michaelis-Menten constant / K_m, is higher with inhibitor ; ora accept comparative data quotes to support answers for ATP concentration, must use $\mu\text{mol dm}^{-3}$ at least once	3
3(c)(i)	without inhibitor, activity of T315L any one from: 1 no activity at $0.1 \mu\text{mol dm}^{-3}$ (ATP) ; 2 maximum rate of reaction / $V_{\max}$, is reached / AW, (for T315L) at a higher concentration (of ATP) ; 3 Michaelis-Menten constant / K_m, is higher (for T315L) ; ora accept comparative data quotes to support answers for ATP concentration, must use $\mu\text{mol dm}^{-3}$ at least once	1
3(c)(ii)	with inhibitor, activity of T315L any two from: 1 activity does not reach TKR, maximum rate of reaction / $V_{\max}$; 2 idea that drug / GNF-5, acts as a non-competitive inhibitor of T315L ; 3 drug / GNF-5, has less of an effect at low concentrations on activity (of enzyme / T315L) ; ora accept comparative data quotes to support answers	2

Answer for Question 19 (9700_s22_22_4)

Question	Answer	Marks
4(a)	R if choice given and one is incorrect carbonic acid ; hydrogencarbonate (ions) ; A bicarbonate (ions)	2
4(b)	<i>any one from:</i> similar / same, active site ; have the same catalytic amino acids ; similar / same, tertiary structure ; A same quaternary structure	1

Answer for Question 19 (9700_s22_22_4)

Question	Answer	Marks																		
4(c)	allow pre-RNA for primary transcript either exon or intron statement required for mp2 to 7, one mark each row any three from: <table><tr><th>exons</th><th>introns</th></tr><tr><td colspan="2">1 both, are (nucleotide sequences that are) transcribed / form part of the primary transcript ;</td></tr><tr><td>2 (DNA/RNA) <u>coding</u> (sequences) R coding genes I exons have the genetic code</td><td>(DNA/RNA) <u>non-coding</u> (sequences) R non-coding genes</td></tr><tr><td>3 (RNA exons) needed / involved / AW, in translation or for formation of, polypeptides / proteins / carbonic anhydrase</td><td>not involved in translation / AW</td></tr><tr><td colspan="2">if mps 2 and 3 not gained 'exons code for proteins' or ora 1 mark</td></tr><tr><td>4 not removed, from primary transcript / from RNA / during gene splicing / during RNA splicing</td><td>removed, from primary transcript / from RNA /during gene splicing / during RNA splicing</td></tr><tr><td>5 (join to) form mRNA / contain mRNA codons A remain in mRNA</td><td>not part of mRNA / in primary transcript only</td></tr><tr><td>6 not involved in regulating activity of genes / AW</td><td>may have regulatory roles A other suggestions for role</td></tr><tr><td>7 AVP e.g. (as part of mRNA) leave the nucleus / go to cytoplasm / go to ribosomes</td><td>AVP e.g. remain in nucleus</td></tr></table> if <u>all</u> are differences and <u>all</u> statements are reversed (i.e. introns for exons and vice versa) max 2 marks	exons	introns	1 both, are (nucleotide sequences that are) transcribed / form part of the primary transcript ;		2 (DNA/RNA) <u>coding</u> (sequences) R coding genes I exons have the genetic code	(DNA/RNA) <u>non-coding</u> (sequences) R non-coding genes	3 (RNA exons) needed / involved / AW, in translation or for formation of, polypeptides / proteins / carbonic anhydrase	not involved in translation / AW	if mps 2 and 3 not gained 'exons code for proteins' or ora 1 mark		4 not removed, from primary transcript / from RNA / during gene splicing / during RNA splicing	removed, from primary transcript / from RNA /during gene splicing / during RNA splicing	5 (join to) form mRNA / contain mRNA codons A remain in mRNA	not part of mRNA / in primary transcript only	6 not involved in regulating activity of genes / AW	may have regulatory roles A other suggestions for role	7 AVP e.g. (as part of mRNA) leave the nucleus / go to cytoplasm / go to ribosomes	AVP e.g. remain in nucleus	3
exons	introns																			
1 both, are (nucleotide sequences that are) transcribed / form part of the primary transcript ;																				
2 (DNA/RNA) <u>coding</u> (sequences) R coding genes I exons have the genetic code	(DNA/RNA) <u>non-coding</u> (sequences) R non-coding genes																			
3 (RNA exons) needed / involved / AW, in translation or for formation of, polypeptides / proteins / carbonic anhydrase	not involved in translation / AW																			
if mps 2 and 3 not gained 'exons code for proteins' or ora 1 mark																				
4 not removed, from primary transcript / from RNA / during gene splicing / during RNA splicing	removed, from primary transcript / from RNA /during gene splicing / during RNA splicing																			
5 (join to) form mRNA / contain mRNA codons A remain in mRNA	not part of mRNA / in primary transcript only																			
6 not involved in regulating activity of genes / AW	may have regulatory roles A other suggestions for role																			
7 AVP e.g. (as part of mRNA) leave the nucleus / go to cytoplasm / go to ribosomes	AVP e.g. remain in nucleus																			

Answer for Question 19 (9700_s22_22_4)

Question	Answer	Marks						
4(d)	<i>allow Hb or hb or Hgb for haemoglobin</i> <i>two marks for points in left column or two marks for points in right column</i> <table><tr><td>cytoplasm / cytosol ;</td><td>(bound to) cell surface membrane ;</td></tr><tr><td>close to haemoglobin (for H⁺ uptake) R in / on / with, hb or <i>idea of being dispersed within cell because haemoglobin is distributed throughout ;</i></td><td>close to, anion exchanger / transport protein, for (easy) exit of hydrogen carbonate (ions) ;</td></tr><tr><td>quick for hydrogen carbonate (ions) to be transported out of cell / AW or H⁺ (from dissociation) binds rapidly to haemoglobin or cytoplasm provides water for reaction to form carbonic acid ;</td><td>able to, hydrate / react with, carbon dioxide as it enters cell ;</td></tr></table> <i>if stated cytoplasm <u>and</u> cell surface membrane, one mark</i> <i>reason can be taken from either column if correctly linked, one mark</i>	cytoplasm / cytosol ;	(bound to) cell surface membrane ;	close to haemoglobin (for H ⁺ uptake) R in / on / with, hb or <i>idea of being dispersed within cell because haemoglobin is distributed throughout ;</i>	close to, anion exchanger / transport protein, for (easy) exit of hydrogen carbonate (ions) ;	quick for hydrogen carbonate (ions) to be transported out of cell / AW or H ⁺ (from dissociation) binds rapidly to haemoglobin or cytoplasm provides water for reaction to form carbonic acid ;	able to, hydrate / react with, carbon dioxide as it enters cell ;	2
cytoplasm / cytosol ;	(bound to) cell surface membrane ;							
close to haemoglobin (for H ⁺ uptake) R in / on / with, hb or <i>idea of being dispersed within cell because haemoglobin is distributed throughout ;</i>	close to, anion exchanger / transport protein, for (easy) exit of hydrogen carbonate (ions) ;							
quick for hydrogen carbonate (ions) to be transported out of cell / AW or H ⁺ (from dissociation) binds rapidly to haemoglobin or cytoplasm provides water for reaction to form carbonic acid ;	able to, hydrate / react with, carbon dioxide as it enters cell ;							
4(e)	exocytosis ;	1						
4(f)	<i>any three from:</i> 1 acetazolamide / inhibitor, binds / attaches / AW, to, allosteric site / site other than active site ; R alternative active site 2 (which) changes, shape / tertiary structure / 3-D structure, of active site ; A active site distorted I protein structure <i>allow ecf for mp3 and 4 if competitive described (to max 2)</i> 3 substrate(s) / CO₂ / HCO₃⁻, cannot, enter / bind to / fit in / AW, active site ; A active site no longer complementary to, substrate / AW A enzyme substrate / ES, complexes cannot form A ESCs cannot form I 'substrate / CO₂ / HCO₃⁻ / 'cannot bind to enzyme' <i>without a link to active site</i> 4 product, not formed / released ; A named product 5 <i>ref. to</i> acetazolamide / inhibitor, leaves, allosteric site / enzyme ; I reversibly binds	3						

Answer for Question 20 (9700_s22_23_5)

Question	Answer	Marks
5(a)	<i>any two from:</i> <i>ref. to can organise / order, enzymes / events, in pathway ;</i> consequence in terms of distance ; e.g. product of one reaction is close to next enzyme (where it acts as substrate) enzyme (more likely to be) closer to substrate distance between enzymes shorter I short distance / less distance to travel, unqualified (so) increases chance of successful collisions between substrate and enzymes ; increased rate of formation of final product or decrease time for ES complex to occur ; <i>idea that products can pass to either side of the membrane ;</i> all reactions, localised / occur in the same location (within the cell) ; AVP ; e.g. membrane provides a source of arachidonic acid I phospholipid	2
5(b)(i)	(similar shaped) curve to the right of main curve <u>and</u> reaches $V_{\max}$; A increasing to reach $V_{\max}$	1

Answer for Question 20 (9700_s22_23_5)

Question	Answer	Marks
5(b)(ii)	stays the same ; increases ;	2
5(c)(i)	the gene / PTGS2, is a sequence of nucleotides, that forms part of a DNA molecule / AW / on chromosome 1 ; A bases codes for (the production of) a, polypeptide / enzyme / COX-2 ; A protein I codes for an amino acid <i>max one if no example used</i>	2
5(c)(ii)	<i>any two from:</i> more, product / compounds, produced that stimulate mitosis ; increased, DNA replication / cell division / mitosis ; I <i>ref. to</i> cancer cells replicating <i>idea that</i> , may lead to / increases chance of / AW, (other) mutations ; mutations can result in oncogenes ; AVP ; e.g. <i>idea that</i> proof checking capacity impaired / increased chance of errors	2

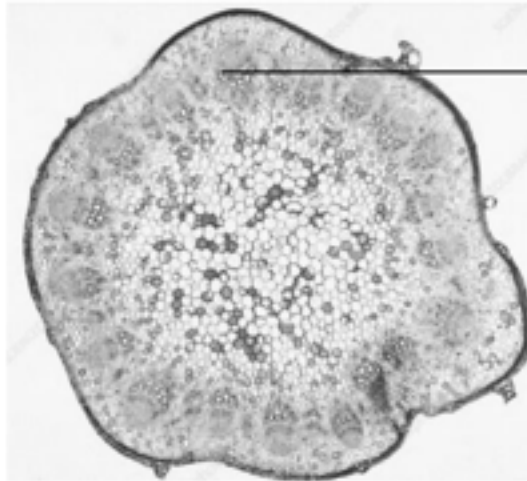
Answer for Question 20 (9700_s22_23_5)

Question	Answer	Marks
5(d)	any three from: phospholipids may be, used in / added to, the (cell surface) membrane ; arachidonic acid, is unsaturated / polyunsaturated ; has, C=C / (carbon-carbon) double bonds ; <i>allow ecf if stated as saturated</i> unsaturated fatty acid tails, have kinks / not linear / AW ; A double bonds produce, kinks / AW increased distance between, phospholipids / other fatty acid tails ; A phospholipids cannot pack closely together less hydrophobic interactions between phospholipid (molecules) ;	3

Answer for Question 21 (9700_w22_21_4)

Question	Answer	Marks
4(a)(i)	no, nucleic acid / genetic material / DNA / RNA ; no, capsid / protein coat ; A no capsomeres only some viruses have envelopes ;	2
4(a)(ii)	heads / phosphate, (groups) of phospholipids are hydrophilic or fatty acid tails of phospholipids are hydrophobic ; A heads are hydrophilic and tails are hydrophobic heads / phosphates, point towards the centre (of the virosome so, must be aqueous / water present) ; ora for tails	2
4(b)	<i>any two from:</i> acts as a <u>non-self / foreign, antigen</u> ; triggers / stimulates, primary immune response or provides (artificial) active immunity ; (leads to) formation of antigen presenting cell ; A endocytosis / phagocytosis, to present antigen (by, macrophage neutrophil) activates, B lymphocytes / T lymphocytes ; A clonal selection formation of memory cells ;	2
4(c)	<i>any two from:</i> no change in, <u>shape</u> / tertiary structure / conformation, of active site ; ora (same) substrate able to bind to active site ; ora consequence ; e.g. so viruses can leave host cell to infect other cells the mutation is not occurring in the, gene / section of gene coding for amino acids in active site for neuraminidase ; the gene for neuraminidase is essential for survival ; AVP ;	2

Answer for Question 22 (9700_w22_21_5)

Question	Answer	Marks						
5(a)	one mark for named pathways ; one mark for outline of apoplastic pathway ; <table><tr><th>name of pathway</th><th>outline of pathway</th></tr><tr><td>symplast / symplastic</td><td>movement of water from cell to cell via plasmodesmata</td></tr><tr><td>apoplast / apoplastic</td><td>movement of water via, cell walls / intercellular spaces</td></tr></table>	name of pathway	outline of pathway	symplast / symplastic	movement of water from cell to cell via plasmodesmata	apoplast / apoplastic	movement of water via, cell walls / intercellular spaces	2
name of pathway	outline of pathway							
symplast / symplastic	movement of water from cell to cell via plasmodesmata							
apoplast / apoplastic	movement of water via, cell walls / intercellular spaces							
5(b)	label line labelled T to any area of xylem tissue ; e.g. 	1						

Answer for Question 22 (9700_w22_21_5)

Question	Answer	Marks
5(c)(i)	lysosome ;	1
5(c)(i)i	any three from: increased permeability to water ; increased, aquaporins / protein channels (in the tonoplast) ; water potential in vacuole is lower than that of cytoplasm ; A more ions in vacuole lower water potential more water enters (vacuole) by osmosis ; vacuole increases, in volume / pressure (until it bursts) ; AVP ; e.g. fewer transport proteins for exit of ions	3
5(c)(iii)	<i>allow two suggestions or a suggestion with further detail, for two marks</i> active site becomes complementary to substrate ; (because) bonds altered between R groups of amino acids ; A hydrogen / ionic, bonds removal of a portion that blocks the active site ; AW substrate can enter active site ; <i>idea of cofactor / AW, associates with the enzyme ;</i> enzymes becomes functional ; sets off an enzyme cascade / ref. cell signalling ; AVP ;	2

Answer for Question 22 (9700_w22_21_5)

Question	Answer	Marks
5(d)(i)	any two from: caused by a pathogen ; <i>idea that</i> it is transmissible / passed from infected plant to uninfected plant ; results in harm being caused / AW ;	2
5(d)(ii)	protocist ; <u>Plasmodium falciparum</u> / <u>Plasmodium malariae</u> / <u>Plasmodium ovale</u> / <u>Plasmodium vivax</u> ; A <i>Plasmodium knowlesi</i>	2

Answer for Question 23 (9700_w22_22_5)

Question	Answer	Marks
5(a)	any three from: accept gly for glycine throughout glycine every third amino acid ; glycine, is, small / smallest, amino acid ; A has H as R-group glycine allows tight coiling of polypeptides to form triple helix ; AW A glycine presence allows a, compact / AW, triple helix gly (-NH) can form hydrogen bonds with (C=O in pro of) other polypeptides of triple helix ; A idea that H bonds can form with other polypeptides in the triple helix AVP ; e.g. pro / ala, also small amino acids (for tight coiling) high proportion of smaller amino acids / amino acids with small side chains A high proportion of glycine <i>if mp1 <u>not</u> given and mp2 is</i> pro can form hydroxyproline for stability ref. insoluble and (some), amino acids with non-polar R-groups (e.g. ala)	3

Answer for Question 23 (9700_w22_22_5)

Question	Answer	Marks
5(b)	any three from: 1 (Golgi /secretory) vesicles, detail ; e.g. packaging of / containing, collagen vesicles bud off from Golgi body <i>context of movement to surface (not movement to other areas within cell)</i> 2 vesicles moved by, microtubules / cytoskeleton (to cell surface membrane) ; 3 ATP required ; A energy required / active process R active transport 4 fuse / merge / combine, with the <u>cell surface membrane</u> ; A <u>plasma membrane</u> 5 AVP ; e.g. budding from trans face of Golgi detail of fusion e.g. phospholipid bilayers merge into one	3
5(c)(i)	any two from: collagen, not broken down / not hydrolysed / breakdown prevented ; A ECM for collagen A less hydrolysis / AW detail ; e.g. suggestion that, collagen does not fit into active site / active site changes shape no / few, ESC / enzyme substrate complexes, form collagen, continues to be, synthesised / released ; A increase in collagen / maintenance of collagen	2
5(c)(ii)	(V_{max}) decreases ; (K_m) stays the same ;	2

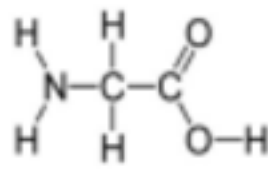
Answer for Question 24 (9700_w22_23_5)

Question	Answer	Marks
5(a)(i)	<i>any two from:</i> 1 <i>idea of</i> the cells have the, same receptor / specific receptor (for LL-37) ; 2 on cell (surface) membrane / inside cell ; 3 (shape of) receptor is complementary to (shape of), cathelicidin / signalling compound / ligand ; I antigen R active site	2
5(a)(ii)	<i>any two from:</i> 1 thin cells ; A (they are) squamous R 'made of squamous epithelial cells' I flat / flattened R 'they have thin (cell) walls' 2 smooth / AW, (luminal) surface ; 3 cells are wider in region of the nucleus ; A nucleus bulges from cell 4 ref to, endothelial pores / fenestrations / pores between cells / gaps between cells ;	2
5(b)(i)	(TTC to TAC) change from phe to tyr (at position 5) ; I 'tyr' unqualified	1

Answer for Question 24 (9700_w22_23_5)

Question	Answer	Marks
5(b)(ii)	<i>allow two marks for</i> new sequence is leu arg val ile ser ser gly asp leu ;; <i>or allow any two from:</i> I refs to frameshift 1 sequence after, first amino acid / first leu, is different ; R 'after position 2' A 'from position 2 onwards' 2 any example ; e.g. amino acid (at position 2) is arg 3 shortened polypeptide / early chain termination ;	2
5(b)(iii)	<i>any two from:</i> peptide is 3 amino acids in length / shortened polypeptide ; stop codon in position 4 ; (third) amino acid is <u>still</u>, gly(cine) / the same ;	2
5(c)	(genetic code) is the, same / similar, in all organisms AW or <i>idea that</i> each triplet codes for the same amino acid in all living organisms ;	1
5(d)	<i>any two from:</i> 1 (most) amino acids have more than one, triplet / codon ; 2 any correct example(s) from Table 5.2 ; <i>if award this then award mp1 as well</i> 3 genetic code is, degenerate / redundant ; R degenerative / degenerated 4 <i>idea that</i> 64 / 61, possible codons for 20 different amino acids ;	2

Answer for Question 25 (9700_m21_22_2)

Question	Answer	Marks
2(a)(i)	sequence of nucleotides or length / section / AW, of DNA ; A bases for nucleotides (a gene can) code for a polypeptide ; A protein for polypeptide	2
2(a)(ii)	 amino group added correctly ; A H₂N (remaining part of) carboxylic acid group added correctly ; A OH for O–H	2
2(a)(iii)	amylose <u>and</u> amylopectin ;	1

Answer for Question 25 (9700_m21_22_2)

Question	Answer	Marks																				
2(b)	one mark for glucose and starch rows ; one mark for maltase row ; one mark for maltose row ; <table><tr><th>substance</th><th>polysaccharide</th><th>monosaccharide</th><th>macromolecule</th></tr><tr><td>glucose</td><td>x</td><td>✓</td><td>x</td></tr><tr><td>maltase</td><td>x</td><td>x</td><td>✓</td></tr><tr><td>maltose</td><td>x</td><td>x</td><td>x</td></tr><tr><td>starch</td><td>✓</td><td>x</td><td>✓</td></tr></table>	substance	polysaccharide	monosaccharide	macromolecule	glucose	x	✓	x	maltase	x	x	✓	maltose	x	x	x	starch	✓	x	✓	3
substance	polysaccharide	monosaccharide	macromolecule																			
glucose	x	✓	x																			
maltase	x	x	✓																			
maltose	x	x	x																			
starch	✓	x	✓																			
2(c)	any one valid suggestion ; e.g. easier to extract idea that microorganisms can be cultured in large quantities and produce large amounts of enzyme higher rate of reaction active over a greater temperature range	1																				
2(d)(i)	any three from: 1 increase in temperature increases kinetic energy of, molecules / particles / substrate / enzyme ; A moving around faster 2 (increase in temperature) increases rate of, successful collisions between enzyme and substrate / enzyme–substrate complex formation / substrate binding to active site ; OR at 48 °C (47 or 49) ref. to, optimum temperature / maximum enzyme activity / active sites binding substrate at maximum capacity / AW ; 3 (at temperatures higher than optimum) ref. to denaturation / loss of shape of active site (and decrease in activity) ; 4 AVP ; e.g. weaker / hydrogen, bonds break (and ref. to denaturation)	3																				

Answer for Question 26 (9700_s21_21_4)

Question	Answer	Marks
4(a)	<i>idea of shape needs to be in the answer for mp2 and mp4 I 'substrate changes shape'</i> <i>any three from</i> 1 active site is not (fully) complementary to substrate ; 2 active site, changes shape / moulds around, to fit the substrate ; A conformational change for shape change 3 <u>enzyme-substrate complex / ESC</u>, forms ; 4 active site returns to original shape on release of product ; 5 AVP ; e.g. change of shape (to give complementary fit) lowers activation energy / puts strain on bonds / AW <i>ref. to binding site / catalytic site (of active site)</i>	3
4(b)(i)	A <i>peroxidase for enzyme</i> <i>any three from</i> <i>rate of reaction increases as substrate concentration increases to 0.33 – 0.35 mmol dm⁻³</i> 1 (up to 0.33 to 0.35 mmol dm⁻³) some active sites are not occupied ; 2 more collisions between, enzyme / active site, and substrate molecules ; A more collisions lead to increase in formation of enzyme-substrate complexes <i>rate of reaction remains constant above 0.33–0.35 mmol dm⁻³</i> 3 all active sites, occupied / saturated ; 4 correct reference to limiting factor for slope ; A limits / limiting e.g. at low substrate concentrations, substrate concentration limiting / enzyme concentration not limiting 5 correct reference to limiting factor for plateau ; A limits / limiting e.g. at high substrate concentrations, enzyme concentration limiting / substrate concentration not limiting	3
4(b)(ii)	<i>idea that determined V_{max} / maximum rate / ref. to 5.6 (μmol min⁻¹) ;</i> A if V_{max} shown on graph K_m is the substrate concentration at half the V_{max} ;	2

Answer for Question 26 (9700_s21_21_4)

Question	Answer	Marks
4(c)	<i>any three from</i> <i>in respiring tissue</i> 1 (carbonic anhydrase) catalyses the reaction between water and carbon dioxide in, red (blood) cells / erythrocytes ; 2 to form carbonic acid, which dissociates to form HCO_3^- and H^+ ; A from equation A use of word ion(s) 3 HCO_3^-, moves / passes / diffuses (through membrane proteins from red blood cells) into plasma ; 4 (activity of enzyme) maintains (steep) concentration gradient for diffusion of carbon dioxide into red blood cells ; 5 <i>idea that</i> so helps to remove large quantities of carbon dioxide ; <i>in lungs</i> 6 (carbonic anhydrase) converts HCO_3^- back into carbon dioxide so can be, excreted / removed / exhaled ; <i>if described earlier A</i> catalyses reverse reaction so carbon dioxide can be, excreted / AW	3

Answer for Question 27 (9700_s21_21_6)

Question	Answer	Marks
6(a)	A rough endoplasmic reticulum ; E Golgi, body / apparatus / complex ;	2
6(b)	transport from, (R)ER / ribosomes, to Golgi ; A from A to E A transport from Golgi to, cell surface membrane / phagosome A separate, acid hydrolases / enzymes, from, rest of cell / AW	1
6(c)	phagocytosis / endocytosis ;	1
6(d)	<i>any three from</i> 1 break down / digest / destroy, bacteria / pathogen(s) ; 2 break down / digest / destroy, (worn out / defective / AW), organelles / named organelle (in animal cell) ; A autophagy 3 catalyse / speed up, <u>hydrolysis</u> ; 4 any two named substrates ; e.g. (any named) polysaccharides / proteins / (phospho)lipids / (named) nucleic acids 5 <i>idea that</i> recycle / reuse, biological molecules within cell ; 6 (macrophage / phagocyte) cut up to present antigen ;	3
6(e)	moves / pump(s), hydrogen ions / protons, into the lysosome against concentration gradient ; active transport / uses ATP / energy from respiration / ref to conformational change of carrier ; R if a ref to facilitated diffusion	2

Answer for Question 28 (9700_s21_22_5)

Question	Answer	Marks
5(b)(i)	<i>any one from</i> (only) polypeptides / proteins, synthesised at ribosomes ; carbohydrates / polysaccharides, not synthesised at ribosomes ; enzymes, for synthesis / required, not located at ribosomes ;	1
5(b)(ii)	exocytosis ;	1

Answer for Question 28 (9700_s21_22_5)

Question	Answer	Marks
5(c)	<i>accept substrate for cellulose and enzyme for cellulase</i> <i>allow use of extracted data to support a response to confirm awarding a mark</i> 1 correct description ; <i>overall trend or more detailed break down</i> e.g. as, cellulose / substrate, concentration increases, rate of reaction increases or as, cellulose / substrate, concentration increases, steep increase in rate of reaction then, less steep increase / (begins to) plateau I 'rate of reaction is fast and then slows down' <i>needs ref. to rate of reaction, describing 'gradient of curve' is not enough</i> <i>plus any two from</i> 2 increasing cellulose concentration increases number of, collisions between enzyme and substrate / enzyme-substrate complexes / ESCs ; A collisions between active site and substrate A <i>idea of</i> increased chances of cellulose binding to active site 3 at low cellulose concentrations, (many) active sites, available / not all used / not saturated ; 4 at higher cellulose concentrations, active sites becoming saturated / most active sites occupied / most active sites not available / AW ; A active sites are, saturated / occupied 5 named limiting factor(s), qualified ; e.g. at low(er) cellulose concentrations, cellulose concentration limiting / enzyme concentration not limiting A <i>idea of</i>, not enough cellulose / enzyme in excess as cellulose concentration increases, change from cellulose concentration limiting to enzyme concentration as limiting factor at higher cellulose concentrations, enzyme concentration limiting / cellulose concentration not limiting A <i>idea of</i>, cellulose in excess / not enough enzyme / enzyme working at its fastest rate / active sites not emptying quickly enough for substrate available	3

Answer for Question 28 (9700_s21_22_5)

Question	Answer	Marks
5(d)(i)	<i>mark to max 2 if microorganisms are considered to be enzyme inhibitors</i> <i>lower K_m for pectinase, any two from ultrasound</i> increases affinity of enzyme for substrate ; makes shape of active site more complementary ; makes (position of) active site more accessible (to substrate) ; A makes it easier for substrate to enter (active site) breaks up pectin, aggregates / AW, to expose more substrate for binding ; <i>higher V_{max} for xylanase, any two from ultrasound</i> increases rate of, collision between enzyme and substrate / more enzyme-substrate complexes per unit time ; I more ESC form <i>needs idea of increased rate</i> increases rate of catalysis after binding ; may change substrate for easier hydrolysis ; may lower, more than normal, activation energy required for reaction ; A described, e.g. increased ability to, break / form, bonds	3
5(d)(ii)	yes (as all have) increased, catalytic efficiency / productivity / V_{max}/K_m ; A manipulated data for increased catalytic efficiency <i>any two from</i> pectin 24.5 / 25% cellulase 17.25 / 17% xylanase 16.8 / 17%	1